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Observations made when following the Grand Trunk Road across the hills of Upper Bengal, Parus Nath, &c. in the Soane valley; and on the Kymaon branch of the Vindhya hills.—By J. D. Hooker, *M. D. R. N. Hon. Member of the Asiatic Society.* (*Communicated by the Hon'ble Mr. Justice* Colvile, *President of the Asiatic Society.*)

The following observations were made with the view of instituting a comparison between the vegetation of the various areas, differing in soil, elevation and general custom, which I traversed (chiefly in company with Mr. Williams* of the Geological Survey,) and the climate which accompanied these changes, and to whose operations the distribution of species is to be traced.

The Instruments used were all of the best construction, chiefly by Newman, and were uninjured up to the last observation recorded. Those made with the portable Barometer, may be relied on as very accurate, the instrument having been adjusted for me with extreme care.

The observations for Temperature were often made where *constant* shade was not to be obtained. Every precaution was however taken to avoid radiated heat.

* I here beg to return my most sincere thanks to Mr. Williams, not only for the opportunity he gave me of observing over a very interesting country: but for the many facilities he afforded and the uniform kind assistance I received, both from himself, Mr. Haddon, and the other gentlemen attached to his camp in which I was a guest. Few travellers have commenced their investigations under such favorable auspices; and to these much of what value the accompanying observations may possess is due.

For the wet-bulb observations, distilled water was invariably employed; and the minimum temperature taken, which is not indicated if the bulb be loaded with water, as is too often the case.

The observations for nocturnal radiation are not so accurate as if a parabolic reflector were used; they are however sufficiently demonstrative of the state of the atmosphere.

Those taken by exposing a naked thermometer on a non-radiating substance, removed from the surface of the earth, as the top of a broad brimmed Shola hat (the bulb quite free) may I think, be depended upon.

Those again indicative of the radiation from grass, whether dewed or dry, are not strictly comparable; not only does the power of radiation vary with the species, but much more with the luxuriance and length of the blades, with the situation, whether on a plane surface or raised, and with the soil upon which it grows. Of the great effect of the surrounding and subjacent soil I had frequent instances; similar tufts of the same species of grass, radiating more powerfully on the dry sandy bed of the Soane, than on the alluvium on its banks; the exposure being equal in both instances.

Experiments for the surface Temperature of the soil itself, are least satisfactory of any:—adjoining localities being no less affected by the nature, than by the state of disintegration of the surface, and amount of vegetation in proximity to the Instrument.

Such observations however are not useless: the mean of a number taken synchronously with those for the Temperature of grass and for free radiation, affording valuable results, especially if compared with the power of absorption by the same soil of the sun's heat during the day.

The power of the sun's rays is so considerable, and protracted through so long a period of the day, that I have not found the temperature of running water, even in large deep streams, so constant as was to be expected.

On a few occasions the temperature of the soil at considerable depths was obtained by sinking holes. My daily progression and the exceeding hardness of the baked alluvial soil, prevented this being fully accomplished, except on a few occasions, and as connected with the Register the observations will be detailed.

A thermometer with the bulb blackened affords the only means the traveller ean generally compass, if measuring the power of the sun's rays. It will be seen that by this I have recorded a greater amount of solar heat than was supposed usual in India.

A good Photometer being still a desideratum, I had recourse to the old wedge of colored glass:—that used was so construeted as to be equivalent to a wedge of a uniform neutral tint, the distance between whose extremes, or between perfect transparency and total opacity was equal to 12 inehes. A moveable arm carrying a brass plate with a slit and a vernier, enables the observer to read off at the vanishing point of the sun's limb, to $\frac{1}{500}$th of an inch. I generally took the mean of four or five observations, but plaee little dependenee upon the results. The eauses of error arc too obvious for notiee here. As far as the effeets of the sun's light on vegetation are conecrned, I am inclined to think that it is of more importanee to register the number of hours or rather of parts of each hour, that the sun shines, and its clearness, during the time. To secure valuable results this should be done repeatedly, and the strength of the rays by the blaek bulb thermometer registered at each hour.

Finally, with regard to the hours at whieh the observations were taken, the three principal ones, 9 A. M., 3 P. M. and 9 P. M. were those adopted by the antarctie expedition. A morning observation was added, beeause the 3 A. M. one is seldom available for the traveller cspecially if, besides the toils of the mareh he has other pursuits. The most useful observations at that hour are perhaps those for the temperature of the grass, soil, &c., which vary little for many eonseeutive hours in the night, and are losing by radiation till the sun's power is felt.

I much regret not being at present able to enter into these computations, which would render the following observations more useful. I have preferred recording them thus early to detaining them for an indefinite period. Their publieation will enable many to point out to me better modes of observation; and direct a few how to eonduct such enquiries. I would also hope there are some who are, like myself, seeking for comparative observations, and to whom these will be welcome, as are all similar ones, made in other parts of India, to me.

The more important results whieh these will give, with more or less aecuraey are:—

The mean height of the granite table-land from Taldanga to Dunwah pass, and of Parus Nath, its culminant point, above the plains of Behar (below the Dunwah pass) and the sea.

The mean height of the plains of Behar from the Dunwah pass to the Soane, and absolute height of pass.

The fall of the Soane between Kemch (above Bidjegurh) and Dearee.

The altitude of Rotas Palace, i. e. of the Kymaon range above Akbarpore.

The altitude of the Ghaton pass in the Kymaon at Roump, and mean altitudes of the Table-land extending thence to the Bind hills at Mirzapore.

Altitude of the plains at Mirzapore. Fall of the Ganges between Mirzapore and Bhaugulpore (approximately).

Mean temperature, Dew-point, force of vapors. Weight of vapor in a cubic inch of atmosphere, and rate of evaporation as calculated from the wet-bulb thermometer on the plains of Behar, and the aforesaid table-land.

Mean amount of nocturnal radiation from the exposed thermometer, from soil and from grass, at the aforesaid place.

The barometrical elevations have been computed with great care,* but so materially does the fluctuation of the mercurial column in Behar, upper Bengal, and the other tracts of country visited, differ from those at Calcutta† that they give but approximate heights.

It has been asserted by a most excellent Meteorologist (Jas. Prinsep) and one more practically familiar with the climate of India than any other; that a few observations made at any part of N. India are so comparable with those at Calcutta, that from such the difference of elevation of the latter and any other station may be deduced with considerable accuracy. This no doubt holds true for the more level

* I cannot sufficiently express my obligation to my friends, J. and C. Muller, Esqs. for the assistance they have afforded me, in these and other computations whose results are detailed in this paper. Many of the observations were reduced by these gentlemen and the elevations determined, and all of them revised from various formulæ, some of them very complicated. What errors therefore are to be attached to the results, may be safely laid to the observer's charge, not to the Instrument, and still less to the computations.

† In Calcutta, in Feb. and March the sunrise observation is generally higher than the 9 P. M, of the previous night—on the hills and plains traversed the opposite was almost always true.

country; but amongst the hills, the changes in the state of the atmosphere are so sudden and their effects so local, that the Barometer there often continues rising during 12 hours or more when the mercurial column is stationary or even falling at Calcutta, and vice versa. There are even instances on record of moderate elevations determined from monthly means, varying upwards of one hundred feet; that of Gurgaon is from the mean of one month's observations, 868 feet; by another month's 817. Nasirabad* (by Lt. Col. T. Oliver) from one month's, 1430 feet, from another 1539 feet: the mean of two following years' observations again shew a perfect accordance. In cases where there have been continued steady weather and coincidence in the fluctuations of the column, much reliance may be placed on the height so computed from a comparison of the indications of good Instruments, provided the proper corrections† be employed. A little practice will give the observer some idea of what indications are most trustworthy. When the elevation is to be calculated from the means of several maximum or minimum observations, it is necessary to take into account the daily range at the two stations; which varies not only at different positions, bu with each month; for instance in February of one year at Calcutta the mean daily tide is 0.147.; and at Kotgurh as low as 0.028.

A considerable amount of difference in elevation is also due to the formula employed; that which I have adopted is the usual one modified by Daniel, who corrects the specific gravity of the atmosphere by the Dew-point.‡ In India the humidity of the air varies so greatly in different stations, that I think this correction should not be overlooked. It is to be remarked however, that (as Mr. Muller first pointed out to me,) in the last edition of Daniell's work, there is a discrepancy in my results as worked by the rule or by the example: the method adopted as shewn by the example, seemed to us the most correct, and except when otherwise stated this is always employed.

A very excellent formula is that used at the Surveyor General's office, for a copy of which I am indebted to Captain Thuillier, an officer to

* Jour. As. Soc. 1835 (January, No. 37. p. 49.

† In those Barometers of Troughton and Simms, used in India, I do not find a measure of the diameter of the tube to accompany the Instrument, and the correction for capillarity is hence too frequently disregarded. The diameter of the bore is generally 0.25 inch, and the consequent correction 0.040 always to be added.

‡ Daniell's Meteorological Essays, Ed. 2. (1845.) v. 2, p. 46.

whom I am exceedingly obliged for the prompt and kind manner in which he has afforded me effectual assistance in various ways.

The Dew-point has been calculated from the Wet bulb, by Dr. Apjohn's formulæ, or, where the depression of the Barometer is considerable, by those as modified by Captain Boileau.* The saturation point, by dividing the tension at the dew point by that at the ordinary temperature. Weight of vapor, by Daniell's formula.

For the means of availing myself of Mr. Williams' kind invitation, so soon after my arrival in India, I am mainly indebted to the President of the Asiatic Society, who not only anticipated my wants by himself equipping me for a mode of travelling widely different from what I had been accustomed to, but has forwarded my views by every means in his power, and shown the warmest interest in my pursuits and kindness to myself. *Darjeeling, Aug.* 1848.

My botanical outfit was all procured for me at the Botanic Garden, by the kindness of Dr. McLelland, to whom I return many thanks for the valuable assistance and advice he afforded me, and the ready manner in which he placed every aid the noble establishment he then superintended could command, at my service.

January 30th.—Joined Mr. Williams' camp at Taldangah, on the Grand Trunk Road, a dawk station near to the western limit of the coal basin (Damoodah valley).

Leaving early the following morning, I had no opportunity of inspecting the fossil plants of this field in situ. An examination of a noble collection sent to England by Mr. Williams, (previous to my departure,) throws but little light on the age of the formation, as compared with the more northern ones. The genera to which the species belong are, some English, a few very remarkable ones Australian, and many others peculiar to the Indian coal fields. The European genera or species, are more allied in appearance to those of the Oolite formation than of the carboniferous æra, but I take this resemblance to be possibly accidental, and not to demand a reference of the Indian coal beds to the period of the English Oolite. Arguing from analogy, it is difficult to suppose that the cotemporaneous Floras of two coun-

* Journal of Asiatic Society, N. 147, (1844) p. 135.

tries as widely remote in geographical position as in physical features, should possess any plants in common: and especially so large a proportion of species, that a recognizable number of these should survive that wreck of a Regnum Vegetabile of whose existence the coal and its accompanying fossils are rather the Index than the Historians. It is certainly very remarkable that any distinct relationship should exist between the English and Indian coal fields, and that it is betrayed by a genus so peculiar as *Glossopteris*, which is further common to the fossil Flora of Australia; but this circumstance loses value from the fact of prevailing forms of Ferns being common to species from all parts of the world, and yet indicating no affinity between such plants, which are only to be recognized by their fructification, an obsolete character in almost all fossil specimens. The Oolite coal of England, again, abounds in representatives of existing tropical plants—these are absent in the Indian coal fields; which on the other hand presents us with novel forms of vegetable life, some of them common only to this and to the Australian fossil Flora, and equally distinct from any known living or fossil vegetables. In short, the Indian coal fossils are more widely dissimilar from any living plants either of the temperate or tropical Flora, than are the fossils of the oldest English carboniferous period. I do not moot the question of the age of these beds in a geological point of view, for that subject is in able hands; though having now visited the Australian, Indian and English Oolite beds, I may add that the two former present the strongest features in common, both in points of extent, and in position (geologically and otherwise), as also a wide difference in their Floras from those flourishing over them.

The Rev. Mr. Everest, in some excellent remarks on this coal field considers the position of the beds relatively to the general features of the surrounding country, as evidences of the coal having been deposited in hollows between the granite hills which rise out of the plain, like islets.*

I had no opportunity of verifying this theory, which is perhaps hardly compatible with the proofs (and these are ample) of the relative position of the coal-beds having suffered much change since their deposition.

* Gleanings of Science, 1831, p. 133.

The workmen employed at the pits use water from the hookah in preference to any other, for the manufacture of gunpowder, but I could not ascertain that there were any good grounds for this choice. The charcoal is made from an *Acacia* (*Catechu ?*) ; that from *Justicia Adhatoda* is more generally used in India ; *Calotropis* wood in Arabia. The pith of all these plants is large, whereas in England, closer-grained and more woody trees, especially willows, are preferred.

A few miles beyond Taldangah the junction of the sandstone and gneiss rocks forming the elevated table-land of upper Bengal, is passed over. From beyond Burdwan the country slopes gradually up to Taldangah, but travelling by dawk at night, I could not estimate the amount of rise. From the latter station the ascent is still gradual, without any material interruption at the change in geological formation. Both sides of the road, and both formations are singularly barren, and the primitive rocks perhaps more so than the sandstone, from the copious effloresced salts, and frequency of masses of granite and quartz protruded through the soil. Good-sized timber is nowhere seen: the trees are stunted, chiefly *Butea frondosa, Diospyros, Terminalia,* and shrubs of *Zizyphus,* and *Acacia, Grislea tomentosa* and *Carissa Carandas.*

The altitude of Gyra is about 652 feet above the sea: it is the first station on the primitive table-land, which extends from this to Dunwah pass, and whose culminant point here is Parus Nath; Main path being another plateau, I believe on the same range of hills, but further S. W. Parus Nath, the eastern metropolis of Jain worship, as mount Abo is the western, is seen towering far above all the other eminences, and so isolated as to form from every side a noble feature in the landscape. All other hills are low ridges, running in various directions. Bamboo certainly forms one third of the jungle on these hills, and from its tints, varying from bright green to absolute whiteness, it gives some variety to the coloring. *Acanthaceæ,* in number of species, prevail beyond any other natural order, both as herbs and bushes; but the *Zizyphus* is the next plant in abundance to the Bamboo, and next the *Carissa Carandas.*

The cultivation is here, as elsewhere along these elevated plains, very wretched, for though alluvion is spread over the schists, the rocks are so dislocated as often to be thrown up at right angles, when their decomposition produces a very barren soil full of salts. The bosses of ungrateful quartz render this sterile country more hungry still. Rice fields are scarce and scattered ; I saw very little corn, grain, or castor oil ; no poppy, cotton or Carthamus. A very little sugar-cane, with dhal, mustard, rape and linseed, include nearly all the crops I observed.* Palms are very scarce and the cottage seldom boasts the banana or tamarind, orange, cocoa-nut or date. The Mahowa tree however is common, and a few Mangoes are seen.

February 2nd.—Marched to Fitcoree, the country being more hilly and still ascending to this station which is 824 feet above the sea. Though the night had been clear and star-light, no dew was deposited, and therefore for the future I took the temperature of the grass, both after sun-set and before sun-rise, as also of a Thermometer with a naked ball exposed to the sky on a non-conducting material. During the whole time I spent on this table-land the temperature of the grass never sunk to that of the Dew-point, though the nights were always fine. The copious dews that I had experienced on the much drier Egyptian desert, between Cairo and Suez, were equally remarkable for their abundance, as their absence is here. The only cause for this that I can assign is an almost imperceptible haze, which may be observed during mornings, producing that peculiar softening of the tints in the landscape which the artist can well appreciate, but whose presence does not interfere with a perfect definition of outlines in distant objects.

The nights too are calm, so that the little moisture suspended in the atmosphere, may be (during these nights) condensed in a thin stratum considerably above the mean level of the soil, at a height determined by that of the surrounding hills. The cooled surfaces of the latter would further favor this arrangement of a stratum of vapor above the heated surface of the earth, with the free radiation from which it would mutually check. Such strata may even be seen, crossing the hills in ribbon-like masses, though not so clearly on the elevated region, as on the plains bounding the lower course of the Soane, where the vapor is more dense, and the hills scattered and the whole atmosphere more humid.

During the 10 days I spent amongst the hills I saw but one cloudy sun-rise, whereas below, whether at Calcutta, or on the banks of the

* The Tussar silkworm is reared in some parts of the hills, especially the northern.

Soane, the sun always rose behind a dense fog-bank. This was when close to Parus Nath, and the effect of a slight east wind, forming, first a stratus amongst the mountains to the west, which gradually rose, obscuring the whole sky with cirrho-cumulus. On all other mornings the sun-rise was clear and cloudless; though through a visible haze.

At $9\frac{1}{2}$ A. M. the black-bulb Thermometer rose in the sun to 130°. The morning observation before 10 or 11 A. M. always gives a higher result than at noon, though the sun's declination is so considerably less, and in the hottest part of the day it is lower still ($3\frac{1}{2}$ P. M. 109°,) an effect no doubt due to the vapors raised by the sun, and which equally interfere with the Photometer observations.* The N. W. winds invariably rise at about 9 A. M. and blow with increasing strength till sunset; they are no doubt due to the rarefaction of the air over these heated plains, and being loaded with dust, the temperature of the atmosphere is raised by the passage of a warm body, which at the same time that it varies the temperature in the shade, depresses the black-bulb Thermometer. The increased temperature of the afternoon is therefore not due wholly to the accumulation or absorption of caloric from the direct sun's rays, but to the passage of a heated current of air derived from the much hotter regions to the westward. It would be interesting to know how far this N. W. diurnal tide extends; and if it crosses the Sunderbunds or upper part of the Gangetic delta; also the rate at which it gathers moisture in its progress over those damp regions. Of its excessive dryness at Benares, Prinsep's observations give ample proof, and I shall compare these with my own observations, both in the valleys of the Soane and Ganges, and on the elevated plains of Behar and Bengal and of Mirzapur.

Observations with the black-bulb Thermometer, though confessedly imperfect, are of considerable interest, and that they have attracted little notice in India is evident from a paper of Capt. Campbell,† who mentions that in Lat. 18° N. 43° is the maximum effect he ever obtained, and that Dr. Baikie has shown 24° to be the maximum on the Neelghery mountains in January. In February and March I have repeatedly observed a difference of upwards of 50°, and on one occasion of 68°. These were in Lat. 25° N. On the Kymaon hills (alt. 1104 ft.)

* See Analysis of Observations.

† Calcutta Journal of Nat. His. v. 2. p. 185.

I have registered the black-bulb Thermometer at 150°, a temperature and difference so little short of what has ever been observed in higher latitudes that we must look to other causes than distance from the Poles for the generally diminished power of the sun's rays in and near the tropics. The low results cited by Daniel* were all obtained from Pelagic stations, as are Capt. Campbell's, compared with my own; nor have I on the tropical and sub-tropical coasts of Africa and S. America, or on the ocean at a distance from land, ever obtained results at all to be compared with these. It is much to be regretted that an instrument so simple and easy of observation should be so neglected. The value of its indications are approximate only, but not the less necessary, as may be gathered from the circumstances of the few experiments I have been enabled to make tending to invalidate a theory grounded on a comparison of all the observations hitherto made in low latitudes.†

* Meteorological Essays, Ed. 2. v. 2. p. 110.

† Since writing the above I have met with a paper by the Rev. Mr. Everest "On the Meteorology of Ghazipur:" in which a record is contained of observations taken with a Thermometer laid on black wool and freely exposed to the sun in the months of September and October. (As. Journ. 1833, p. 605.) The range of the exposed Thermometer in these observations coincides very nearly with my own. The maximum being attained at 11 A. M. and the greatest difference observed is also at that hour (50°.6).

Dr. McLelland,* who has made some excellent analyses of the meteorological phenomena of India, attributes the haze of the atmosphere during the N. W. winds of this season, wholly to the suspended earthy particles. That such may be the case to a great degree is clear, for the amount of the haze is evidently proportioned to the force of the wind during the prevalence of the Diurnal breeze. But the haze is always present, even in the calmest weather, when it is only to be accounted for by the hygrometric state of the atmosphere. Extreme dryness, (which here is so marked that there is no deposition of dew,) is in all parts of the world usually accompanied by an obscure horizon.

Capt. Campbell also objects to the conclusiveness of Dr. McLelland's theory, citing those parts of Southern India which are least likely to be visited by dust storms, as possessing an equally hazy atmosphere, and further denies its being influenced by the hygrometric state of the atmosphere. (Cal. Journ. Nat. His. v. 2. p. 44). I have observed the same phenomenon in oceanic islands, when the surface rocks were powerfully heated by a tropical sun, and the air extremely dry, and I have further remarked a brilliantly clear atmosphere with a similarly low Dew point in the Antarctic Ocean, where the horizon was ice-bound: hence it is probably not so much the amount of vapor as its tension that determines the transparency of the atmosphere.

When on this subject I may add that even on the ocean the air is sometime so brilliantly clear that Venus is visible at mid-day during a strong sun-light. I have seen that planet in the north tropical Atlantic under similar circumstances to what Dr. Campbell did at Kemedy, (Cal. Journ. Nat. His. v. 2, p. 279,) but have not with me the date or corresponding observations.

* Cal. Journ. Nat. His. v. 1, p. 52.

February 2nd.—Proceeded on to Tofe-choney (or Top-chaunsee.) General features similar to those of yesterday, but the country more wooded and ascent considerable; alt. of station 900 feet. Tanks here are covered with the usual water plants of India: *Villarsia Cristata, Nymphæa, Chara* and *Potamogeton.* The increased shade favors the growth of several ferns, as *Lygodium, Pteris, Adiantum, Cheilanthes* and *Selaginella.* The situation near the foot of Parus Nath, a heavily timbered lofty mountain rising abruptly, and terminated in a rugged ridge, is very pretty. A few rock Lichens are found here. Many trees appear, with *Nauclea, Bignonia, Combretum* and *Bauhinia, Gmelina arborea* and *parvifolia. Butea frondosa* continues abundant. In this district the greater proportion of Stick-Lac is collected from *Butea;* in Mirzapur, a species of Sponia yields it, and the Peepul very commonly in various parts of India. The elaboration of this dye, whether by the same species of insect, or by many from plants so widely different in habit and characters, is a very curious fact.

February 3rd.—At 3 A. M. the temperature was 55°, and to the feeling very cold. This being the most convenient station from whence to ascend Parus Nath, we left early in the morning for the village of Maddaobund, on the north base of the mountain, from whence a good path leads to the summit.

Following the Grand Trunk Road for a few miles to the west, after passing the base of the mountain, a narrow path strikes off to the north winding through low valleys and over finely wooded plains, covered with noble trees of *Bassia,* like Oaks in a park, *Fici, Gmelina,* two species of *Diospyros, Buchanania latifolia, Nauclea cordifolia, Semicarpus anacardium, Bauhinias,* with clumps of large Bamboo. The uudershrubs are still of *Vitex, Carissa, Grislea tomentosa, Zyzyphi,* and stunted *Butea;* the grapes wiry and harsh, *Adropogons, Anthristia, Saccharum,* &c. Somc villages at the west base of the mountain occupy a better soil and are surrounded with richer cultivation; palms and mangoes and the tamarind, the first and last rare features in this part of Bengal, appeared to be common here, with fields of rice and broad acres of Flax aud Rape, through the latter of which the blue *Orobanche Indica* was swarming. The short route to Maddaobund, through narrow rocky valleys, was impracticable for the elephants, and we had to make a very considerable detour, only reaching that village (on the north base of the mountain) at 2 P. M. All the hill people we had observed were a fine-looking athletic race; they disown the tiger as a neighbour, which every palkee-bearer along the road declares to carry off the torch-bearers, torch and all. Bears they say are scarce and all other wild animals.

The site of Maddaobund, elevated 1217 feet, in a clearance of the forest, is very beautiful. Fine tamarind trees and a superb Banyan shadow its temples, and the ascent is immediately from the village up a pathway worn by the feet of many a pilgrim, from the most remote parts of India.

The village was crowded with worshippers, whose numerous vehicles of all shapes and build, reminded one of an electioneering in an English country-town. Though so well wooded the forests of its base are far from rich in species of plants.

February 4th.—At 6½ A. M. having provided chairs slung on four men's shoulders, in which I put my papers and boxes, we commenced the ascent; at first through woods of the common trees, with large clumps of Bamboos, over slaty rocks of gneiss, much inclined and sloping away from the mountain. The view from a ridge 500 feet high was superb, of the village, and its white domes half buried in the forest below, and of the latter, continued for many miles to the northward. Descending to a valley some Ferns were met with, and a more luxuriant vegetation, especially of *Urticeæ*. Wild Bananas formed a beautiful, and to me novel feature in the woods; these I took for granted were planted, but I have since heard that the plant is wild in the Rajmahal hills, N. E. of this (and of which these mountains are a continuation) and hence no doubt here also. A white-flowered Rubiaceous plant (*Hamiltonia suaveolens*) was everywhere abundant, and very handsome, with many *Acanthaceæ* and *Leguminosæ*, but few *Cryptogamiæ*. The mounds raised by the white-ant appear to me not an independent structure, but the debris of clumps of Bamboos, or of the trunks of large trees which these insects have destroyed. As they work up a tree from the ground, they coat the bark with particles of silicious soil, glued together, carrying up this artificial sheath or covered way as they ascend. A clump of Bamboo is thus speedily killed, the culms fall away, leaving the mass of stumps coated with sand, which the action of the weather soon fashions into a cone of earthy matter.

Ascending again, the path strikes up the hill, through a thick forest of *Sal (Vateria robusta)* and other trees, spanned with cables of scandent *Bauhinia* stems. At about 3000 feet above the sea, the vegetation becomes more luxuriant, and by a little stream, I collected 5 species of Ferns, some Mosses and *Hepaticæ,* all in a dry state however; *Ficus artocarpifolia ?* which sends hanging tufts of leafless twigs from the limbs, was abundantly covered with fruit. Some *Smilaceæ, Disporum, Clematis,* a terrestrial Orchideous plant, and *Arginetia,* next appeared, and still ascending *Roxburghia viridiflora,* an increased number of grasses and *Cyperaceæ* are met with; the *Hamiltonia* ceases, and is succeeded by other bushes of *Verbenaceæ* and *Compositæ.* The white-ant apparently does not enter this damper region. On ascending to 3500 feet the vegetation again changes, the trees all become gnarled, stunted, and scattered, and as the dampness also increases, more Mosses and Ferns appear. Emerged from the forest at the foot of the great ridge of rocky peaks, stretching E. and W. 3 or 4 miles. Abundance of a species of Barberry and an *Osbeckia* marked the change in the vegetation most decidedly, and were frequent over the whole summit, with coarse grasses, *Cyperaceæ,* and various bushes.

At noon reached the saddle of the crest, where was a small temple, one of 5 or 6 which occupy various prominences of the ridge.

The wind, N. W. was cold, the temp. 56°. The view beautiful, but the atmosphere too hazy. To the north ranges of low wooded hills, and the course of the Barracker and Adji rivers. To the south a flatter country, with lower ranges, and the Dummoodah river, its all but waterless bed snowy white from the exposed granite blocks it strews along its course. East and west the several sharp ridges of the mountain itself; the western considerably the highest, and each crowned with a white temple. Immediately below, the mountain flanks appear, clothed with impenetrable forest, here and there interrupted by rocky eminences. To the north the Grand Trunk Road shoots across the plains, like a white thread, stretched as straight as an arrow, spanning here and there the beds of the mountain torrents, with the pretty bridges of my friend Lieut. Beadle.

On the south side the vegetation was more luxuriant than on the north, though from the heat of the sun the opposite might be expected. This is owing partly to the curve taken by the ridge being open to the south and to the south winds being the damp ones. Accordingly, plants which I had left 3000 feet below in the north ascent, here ascended to near the summit, such as *Fici,* Bananas and various weeds. A small short-stemmed Palm (*Phœnix*) was tolerably abundant, (propably *P. Ouselayanæ,* Griff.) and a small tree of *Pterospermum,* on which a species of grass grew epiphytially: but too withered to determine; it formed a curious feature.

The situation of the principal temple is very fine, below the saddle in a hollow facing the south, surrounded by forest and the Banana and Banian. It is small but handsome, contains little inside to remark, but the sculptured feets of Parus Nath and some slabs of marble with Boodh idols; cross-legged figures with crisp hair and the brahminical cord. These, a leper covered with ashes in the vestibule and an officiating priest, were all we saw.

Pilgrims were seen on various parts of the mount in very considerable numbers, passing from one temple to another, and leaving generally a few grains of dry rice at each; the rich and lame were carried in chairs, the poorer walk.

The culminant rocks are very dry, but in the rains may possess many curious things; a fine *Kalanchoe* was common, with the Barberry, a beautiful *Indigofera,* and various other shrubs; a *Bolbophyllum* grew on the rocks, with a small *Begonia, Telaginella, Davallia* and some other Ferns. There were no birds, and very few Insects, a beautiful small *Pontia* the only butterfly. The striped squirrel was very busy amongst the rocks, which, with some mice and the traces of bears, includes all I can say of the Zoology of the summit.

On the top and shoulders of the hill there is a considerable space for establishing a small Sanatarium, and the climate is no doubt highly advantageous, as is the proximity to Calcutta, and the acceptability of the country. Mainpath however, is probably a far more eligible site, equal or nearly so in altitude, much more extensive and only a night's dawk from the Grand Trunk Road. The height of the saddle I made to be 4,233 feet,* above the sea, and the following observations may

* Calculated by Daniell's Formula, for correcting the specific gravity of air by the Dew-Point. By Sir G. Shuckburgh's Formula, the height is 4,261.8 feet. Of the two Peaks visited the easternmost is 4,148.4, the flag-staff 4,348.2. feet.

give some idea of the temperature as compared with that of Calcutta and the plains below the mountain.

Comparision of Wooded-gully in Parus Nath.

Alt. 2,126 ft., with Plains at Base alt. about 1000 ft. and Calcutta at 9 A. M.

	Wooded-gully.		*Base.*		*Calcutta.*
Temp.	51.5	....	70.1	....	67.
D. P.............	36.7	....	37.9	....	38.8
Diff.	14.8	....	32.2	....	28.2
Saturation.	0.601	....	0.330	....	0.385
Elast. of vapour...	0.253	....	0.264	....	0.270

Interesting as the Botany of Parus Nath proved, its elevation did not produce such a change from the flora of its base as I had expected. This is no doubt due to the extraordinary influence of a dry atmosphere and barren soil. That the atmosphere of the summit is more damp as well as cooler than at the base, is proved as well by the observations as by the vegetation; the results of the former as compared with the means of those taken below are:

Comparison of Saddle or Crest of Parus Nath with Calcutta, and with the Plains at the base of the mountain, at 3 P. M. Feb. 4th.

	Parus Nath.		*Plains at foot of.*		*Calcutta.*
Temp.	54°.	....	75.5	....	74.4
D. P.............	21°.8	....	36.0	....	36.5
Diff.	32°.2	....	39.5	....	37.9
Sat.	0.326	....	0.260	....	0.282
Vap. c. f.	1.658	....	2.674	....	2.719
Elast.	0.150	....	0.248	....	0.252
Wind.	N.W.	....	N.W.	....	N. W.
Sky............	Hazy.	....	Hazy.	....	Clear.

Of plants eminently typical of a moister atmosphere, I may mention the genera *Bolbophyllum, Begonia, Ferns, Æginetia, Disporum, Roxburghia, Panax, Eugenia, Myrsine, Shorea, Millettia,* the Mosses and foliacious Lichens; which appeared in uncomfortable association with such dry climate genera, as, *Kalanchoe, Pterospermum,* and the dwarf *Phœnix.* Add to this list the Barberry, *Clematis, Thalictrum,* 27 grapes, *Cardamine,* &c., and the mountain top presents a mixture of the plants of a damp hot, a dry hot, and of a temperate climate, in fairly balanced proportions. The prime elements of a tropical Flora were however wholly wanting on Parus Nath, where are neither *Peppers, Pothos, Arum, Palms,* (except the starveling *Phœnix,*) tree ferns, *Scitamineæ* at this season, *Guttiferæ, Vitis* or *Laurineæ.*

In the evening returned to the village, I left early on the following morning, following Mr. Williams' camp who had gone on to Sheergottee.

In the valleys near the base of the hill were many fine trees, the *Buchanania latifolia* abounds, with large *Terminalias, Diospyros, Lagerstrœmia,* and *Wrightea tinctoria.* A magnificent *Cæsalpinia (paniculata ?)* hung in festoons over some of the trees, a perfect cataract of golden blossoms, relieved by a dark glossy foliage.

At Doomree (alt. 986 ft.) the hills are of gneiss, and hornblende schist, with a great deal of quartz ; no palms or good trees of any kind. The curious genus *Balanites,* with *Ægle marmelos* form abundant bushes. The spear-grass is far too common for comforts in Botanizing.

Feb. 6th.—Left Doomree, walking, for Lieut. Beadle's Bungalow. The country around Baghodur is still very barren, but improves considerably in going westward, the ground becoming hilly and the road winding through prettily wooded valleys. *Nauclea cordifolia* is very common and resembles a young Sycamore. Crossing some well-bridged streams the road rises a good deal, and at the highest point measured 1429 ft. above the sea. The *Bombax,* (Semul) now leafless, is not uncommon, and a very striking tree from its buttressed trunk and gaudy scarlet flowers, swarming with birds, which feed from its honeyed blossoms.

At 10 o'clock the sun became uncomfortably hot, the Therm. being only 77°, but the black-bulb Therm. 137°. At noon arrived at Lieut. Beadle's at Belcuppee, from whom I experienced a most hospitable welcome. Staying there two days I enjoyed his society during several excursions to the hot spring, &c. I further profited much by his excellent knowledge of coloring and appreciation of the natural features of the surrounding country to which the beauty of its landscape is due. The most frequent trees are still the oak-like *Mahowa* (*Bassia*), *Nauclea,* Mango, and *Ficus infectoria.* These are all scattered however, and do not form forest, such as in a stunted shape, clothes the hills, and consists of *Diospyros, Terminalia, Gmelina, Nauclea parvifolia, Conocarpus,* &c.

The rocks are still hornblende schists and gneiss with a covering of alluvium full of quartz pebbles. Effloresced salts are frequent in the exposed rocks, and probably inimical to *Lichens,* which though common hardly ever assumed the foliaceous form. Insects and birds are more numerous, with Jays, Crows, Doves, Sparrows and Maina (Pastor), also the *Phœnicophaus tristis,* (Mahoka of the natives,) with a voice like the English Cuckoo as heard late in the season.

Height of Belcuppee above the sea 1139 feet.

In the evening visited the hot-springs, situated close to the road. These are four in number, rise in as many little ruined brick tanks, about 2 yard across. Another tank, fed by a cold spring, about twice that size, flows between too of the hot, and only two or three paces distance from one of the latter on either hand.

All burst through the gneiss rocks, meet in one stream after a few yards, and are conducted to a pool of cold water, about 80 yards off, by bricked canals.

The temperatures of the hot springs were respectively 169°, 170°, 173° and 190°; of the cold, 84° at 4 P. M. and 75° at 7 A. M. of the following morning. The hottest is the middle of the five. The water of the cold spring is sweet but not good, and emits gaseous bubbles; it is covered with a green floating *Conferva.*

Of the four hot, the most copious is about three feet deep, bubbles livelily its gasses, boils eggs, and though brilliantly clear, has an exceedingly nauseous taste. This and the other warm ones deposit salt in a very concrete state, on the bricks and surrounding rocks.

Confervæ abound in the warm stream from the springs, and two species, one ochreous brown, and the other green, occur on the margins of the tanks themselves, and in the hottest water; the brown is the best Salamander, and forms a belt within the green: both appear in broad luxuriant strata, where the water is cooled down to 168° and below to 90°. Of flowering plants, three showed in an eminent degree a constitution capable of resisting, if not a predilection for the heat; these were *Cyperaceæ* all, a *Cyperus* and *Eleocharis?* having their roots in water of 100°, and where they are probably exposed to greater heat, and a *Fuirene?* at 98°; all were very luxuriant.

From the edge of the four hot springs I gathered seven or eight species of flowering plants, and from the cold tank five, which did not grow in the hot.

A water-beetle, *Colymbetes?* and *Notonecta*, abounded in water at 112°, with quantities of dead shells; frogs were very lively with live shells, at 90°, with various water beetles. Having no means of detecting the salts of this water, I bottled some for future analysis. The situation of these springs (called Sooroochh-kand) is very pretty, near the mouth of a valley. They are objects of worship of course, and a ruined temple is seen close behind, with three very conspicuous trees, a white thick stemmed and leafless *Sterculia*, whose ramuli bore dense clusters of greenish red, fetid and viscid flowers;—a Peepul and a Banyan.

On the following day I botanized in the neighbourhood with but poor success; an oblique-leaved *Ficus* climbs the other species and generally strangles them. Two other epiphytial *Orchideæ* occurred on the trees besides the one previously alluded to, an *Angræcum* and *Oberonia*. *Cuscutæ* of two species swarm over and conceal the bushes with their yellow filaments, especially choking the *Vitex Negundo? Mucuna* is common, and a most disagreeable intruder, the cowitch of its pod flying about with the wind and causing intolerable irritation.

February 8th.—Left Lieut. Beadle's early, following Williams' camp. The morning was clear and cold, the temperature only 56° ; crossed the nearly empty broad bed of the Burkutta river, a noble stream in the rains, carrying along huge boulders of granite and gneiss.—Still ascending, measured the highest part of the road, 1492 feet, and suddenly came on a small forest of a peculiar looking tree, quite new to me. This proved to be the Indian Olibanum, *Boswellia thurifera*, conspicuous for its pale bark, and patent curving branches, leafy at the apices. Its general appearance is a good deal that of the mountain Ash; and the leaves, now copiously falling, and red in age, were actually reddening the ground. The gum was flowing abundantly from the trunk, very fragrant, clear and transparent. Many of the trees were cut down and had pushed leafy ramuli in great abundance from the stumps. The ground was dry and rocky with little other vegetation, no *Orchideæ* grew on the trees, and but little grass under foot. Kunkar here reappears in the alluvium. Another *Phœnix* occurred here, similar to, but different from the Parus Nath species, probably *P. acaulis;* it is wholly stemless, and I saw male flowers only.

Suddenly descending to the village of Burshoot, lost sight of the

Boswellia, and came upon a magnificent tope of Mango, Banyan and Peepul, so far superior to any thing hitherto met with, that we were glad to have hit on so pleasant a halting-place for a bivouac. There are a few lofty *Borassi* here too, great rarities in this soil and elevation; one about 80 feet high towered above some wretched hovels; displaying the curious proportions of the trunk in this tribe of Palm: first a short cone, tapering to one-third the height of the tree, the trunk then swells to two-third height, and again contracts upwards to the crown.

Beyond this, to Burree, the country ascends again, is tolerably wooded, but otherwise sterile and very dry. Burree (1275 feet) is a barren place, which we left at daylight on the morning of February 9th. So little to be observed that I had recourse to examining footsteps, the precision of which in the sandy soil was curious: looking down from the elephant I was amused to see them all in relief, instead of depressed, the slanting rays of the eastern sun producing this mirage: the effect was curious. Crossed another shoulder of a hill on this undulating road, at an elevation of 1524 feet, and descended to the broad stony bed of the Barrucker river, an affluent of the Dummoodah, and hence of the Hooghly. Except in some cotton cultivation, there was little to be seen, and before us no more of the wooded hills that had been our companions for the last 120 miles, and whose absence is a sign of the near approaching termination of the great hilly plateau we had traversed for that distance. Chorparun,* the next halt, is situated on an extended barren flat, 1311 feet above the sea, and from it the descent from the table-land to the plains below is very sudden.

February 10*th.*—At daylight left Chorparun, and descended the ghat or Dunwah pass, as it is called, to the great valley of the Soane, and to the level of that of the Ganges at Patna. The road, though very steep, is admirably carried zigzag down a broken hill of gneiss, with a descent of nearly 1000 feet in 6 miles, of which 600 is exceedingly rugged and steep. The pass is well wooded, with small trees, among which the *Boswellia* is conspicuous, now pushing its flowers from the leafless apices of the branches. Quartz and Felspar are the prevalent minerals, and barren enough in every respect, except supporting this low rugged wood and abundance of Bamboo; *Bombax, Cassia, Acacia*, and *Butea* are likewise frequent, as is a *Calotropis*, the purple

* Hill above Chuparun, 1322 ft.

Mudar, a very handsome road-side plant, which I had not seen before, but which, with the *Argemone Mexicana* was to be a companion for hundreds of miles before me. All the views in the pass are very picturesque, though wanting in good foliage, such as *Ficus* would afford, of which I did not see one tree. Indeed the rarity of the genus (except *F. infectoria*) in the native woods of these plains I have traversed, is very remarkable. The Banyan and Peepul appear, (as the tamarind and mango and Mahowa ?) always planted.

Dunwah, at the foot of the pass, is 633 feet above the sea, and nearly 1000 below the mean level of the highland I had left. Every thing bears here a better aspect; the woods at the foot of the hills afforded better botanizing; the Bamboo (B. stricta ?) is green instead of yellow and white; a little castor oil is cultivated, and the *Phœnix sylvestris* (low and stunted) appears about the cottages.

In the evening left Dunwah for Bahra, the next stage, over very barren soil, covered with low jungle, the original woods being apparently cut for fuel.

February 11th.—Left Bahra, alt. 477 feet (from one observation at sunrise only) at daylight, for Sheergotty,* where Mr. Williams was waiting our arrival. Wherever cultivation appears the crops are tolerably luxuriant, but a great deal of the country is very barren, yielding scarcely half a dozen kinds of plants to any 10 square yards of ground. The most prevalent were *Alax scandens,* two *Zizyphi,* and the ever-present *Acacia Catechu ?* and *Carissa carindas.* The climate is however considerably warmer and much moister, for I here observed dew to be formed, which I afterwards found to be usual on the low grounds. That its presence is due to the increased amount of vapor in the atmosphere I shall prove, the amount of radiation, as shown by the cooling of the earth and vegetation, being the same in the elevated plain and lower levels.

The following is an abstract of the Meteorological observations I was enabled to make. From these it is evident that the dryness of the atmosphere is its most remarkable feature, the temperature not being great, and to this, combined with the sterility of the soil over a great part of the surface, must be attributed the want of a vigorous vegetation. Though so favorably exposed to the influence of nocturnal radia-

* Alt. of road, at 284th mile-stone, 474 ft.

tion the amount of the latter is small. The maximum depression of a Thermometer laid on grass never exceeding 10°, and averaging 7° ; the average depression of the dew point at the same hour amounting to 25° in the morning ; of course no dew is deposited, even in the clearest star-light night, which I attribute in part to the extreme desiccation, and in part to the operation of the light haze alluded to above.

Table-land of Birbhoom and Behar.

	Temperature.				Wet Bulb.			Elasticity of Vapor.	Dew Point.					Weight of Vapor in cubic feet.	Saturation.			Number of observations.
	Mean.	Max.	Min.	Range.	Mean.	Max. Depression.	Min. Depression.		Mean.	Max.	Min.	Max. Depression.	Min. Depression.		Mean.	Max.	Min.	
Sun-rise ..	56.6	65.2	46·3	18.9	48.2	12.5	6.0	.276	39.5	52.0	23.3	31.7	10.4	3.088	.550	.680	.330	7
9 A. M. ..	70.1	77.0	61.2	15.8	53.7	19.3	14.3	.264	37.9	52.7	24.5	39.2	24.3	2.875	.330	.450	.260	7
3 P. M.····	75.5	81.7	65.2	16.5	55.3	22.5	16.7	.248	36.0	46.8	24.3	48.4	34.9	2.674	.260	.320	.190	7
9 P. M.····	61.7	66.2	55.5	10.7	49.3	20.5	9.0	.248	36.1	50.0	*9.1	56.9	16.2	2.745	.410	.590	.140	10

Extreme variations of Temperature························ 35°.4

,, ,, ,, Saturation························· 54.0

,, diff. between Solar and Nocturnal Radiation···· 96°.5

* Taken during a violent N. W. dust storm.

Table-land of Behar and Beerbhoom.

Solar Radiation.

Morning.					*Afternoon.*				
Time.	Th.	Black Bulb.	Diff.	Phot.	Tim.	Th.	Bla Bulb.	Diff.	Phot.
9½ A. M.	77.0	130	53.0	..	3½	81.7	109	27.3	..
10..........	69.5	124	54.5	10.320	3	80.5	120	39.5	10.320
10..........	77.0	137	60	..	3	81.5	127	45.5	10.330
9..........	63.5	94	30.5	10.230	3½	72.7	105	32.3	10.230
9..........	61.2	106	44.8	..	3	72.5	110	37.5	10.390
9..........	67.0	114	49.0	10.350	..	..	..	..	..
Mean.......	69.2	117.8	48.6	10.300	..	7 7.7	114.2	36.4	10.318

Table-land of Birbhoom and Behar.

Nocturnal Radiation.

	Sunrise.				9 P. M.			
	Temperature.	Mean Diff. from Air.	Max. Diff. from Air.	Number of observations.	Temperature.	Mean Diff. from Air.	Max. Diff. from Air.	Number of observations.
Exposed Th.	51.1	4.	9.0	6	56.4	5.3	7.5	7
On Earth.	48.3	2.5	3.7	3	53.8	4.9	5.5	6
On Grass.	46.6	6.2	9.0	5	54.4	7.2	10.0	7

On one occasion, and that at night, the dew point was as low as 9°.1, with a temperature of 66°, a depression rarely equalled at so low a temperature; this phenomenon was transient and caused by the passage of a current of air loaded with dust, whose cooling particles possibly absorbed the atmospheric humidity. I neglected to collect any of the powder. From a comparison of the night and morning observations of Thermometers laid on grass,—the earth,—and freely exposed, it appears that the grass parts with its heat much more rapidly than the earth, but that still the effect of radiation is slight, lowering its temperature but 2° below that of the freely exposed thermometer.

As compared with the climate of Calcutta these flat hills present a remarkable contrast, considering their proximity in position and moderate elevation.

The difference of temperature, dedueed from the sunrise morning and afternoon observations, amounts to 4°, which, if the mean height of the hills where crossed by the road, be called 1133 feet, will be equal to a fall of one degree for every 288 feet. This is below the usual equivalent for that height: Playfair assuming, 1° equal to 270 feet of elevation, and more recent observers 1° as equal to 250 feet. A comparison of the solitary temperature taken at the top of Parus Nath with the cotemporaneous one at Calcutta, gives 1° of temperature for every 211 feet, which is again much above the assumed standard.

In the dampness of the atmosphere Calcutta contrasts very remarkably with these hills; the dew point on the Hooghly averaging 51°.3, and on these hills 38°, the corresponding saturation points being 0.559 aud 0.380.

The differences between sunrise, forenoon and afternoon dew points at Calcutta and on the hills, are 13°.6 at each observation ; but the atmosphere at Calcutta is proportionably drier in the afternoon than at sunrise, than it is on the hills : the difference between the Calcutta sunrise and afternoon saturation point being 0.449 : and the hill sunrise and afternoon, 0.190. The march of the dew point is thus the same in both instances, but owing to the much higher temperature of Calcutta, and greatly increased tension of the vapor, there the saturation points answering to these dew point temperatures, are very different.

In other words, the atmosphere of Calcutta is loaded with moisture in the early morning of this season, and is comparatively dry in the afternoon ; in the hills again, it is scarcely more humid at sunrise than at 3 P. M. That this dryness of the hills is partly due to elevation appears from the disproportionately moister state of the atmosphere below the Dunwah pass.

A retrospect of the ground passed over is unsatisfactory, as far as botany is concerned, except as showing how potent are the effects of a dry soil and climate, upon a vegetation which has no desert types. At another season, probably many more species would be obtained, for of annuals I scarce got a score of species. In a geographical point of view the range of hills is exceedingly interesting, as being the N. E. continuation of a chain which crosses the broadest part of the Peninsula, from the gulf of Cambay to the junction of the Ganges and Hooghly at Rajmahal. This range runs south of the Soane and Vindhya, which it meets I believe at Omerkuntuk ; the granite of this and the sandstone of the other, being then both overlain with trap. Further west again, the ranges separate, the present still betraying a nucleus of granite, forming the Satpur range, which divides the valley of the Taptee from that of the Nerbudda. The southern is, though the most difficult of definition, the longest of the two parallel ranges, the Vindhya continued as the Kymaon, terminating abruptly at the Fort of Chunar. The general and geological features of the two, especially along their eastern course, are very different. This of gneiss, hornblende-schists and granites, in various highly inclined beds, through which granite hills are pushed, most of them low, but one culminating remarkably, Parus Nath, around whose base the overlying gneiss rocks dip, radiating from it. The N. E. Vindhya again are of flat beds of sandstone, presenting a dead level, with no eminences or signs of upheaval, overlying a non-fossiliferous inclined bed of limestone. Between the latter and the Parus Nath gneiss, come (in order of super position) shivered and undulating strata of metamorphic quartz, hornstone, hornstone-porphyry, jaspers, &c. These are thrown up, by volcanic action, along the N. and N. W. boundary of the gneiss range and are to be recognized, at the rocks of Colgong, of Sultangunge and of Monghyr, on the Ganges, as also various detached hills near Gya, and along the upper course of the Soane. From these the Soane pebbles are derived, which are equally common on the Curruckpore range, as on the south banks of the Soane :—so much so in the former position, as to have been used in the decoration of the walls of what are now ruined palaces near Bhaugulpore.

A very gradual ascent, over the alluvial plains of the west bank of the Hooghly, then over laterite, succeeded by sandstone of the Indian coal era, leads to the granite table-land properly so called; a little beyond this the latter reaches an average height of 1130 ft. which is continued on upwards of 100 miles, to the Dunwah Pass, in short. Here the descent is sudden, to the plains, which, continuous with those of the Ganges, run up the Soane till its valley is narrowed beyond Rotasghur. Except for the occasional ridges of metamorphic rocks mentioned above, and some intruded hills of greenstone, the lower plain is stoneless, its subjacent rocks being covered with a thicker stratum of the same alluvium, which is thinly spread over the higher parts of the table-land above, though even there collected in beds of enormous thickness in the depressions. The plain here dividing the Kymaon range from that of Parus Nath, is full 80 miles across, with a mere elevation of 400 ft.; beyond which the ascent to the Kymaon is more abrupt than 400 in the descent at Dunwah. This alluvium is, to my as yet unpractised eyes, a most remarkable formation, and with its inclosed kunker, appears as if deposited quietly and synchronously over the Kymaon, the Parus Nath range and the intervening broad valley of the Soane. Broad bold and headstrong as the latter river is, it seems to have played no part in the formation of its own valley, for in its upper bed, where the valley is scarcely two miles wide, and where the Kymaon sandstone escarpments all but plumb the river, there is still a narrow strip of dead flat alluvium, with kunker, as hard and tough as many rocks, through which the river eats its way, cutting channels with perpendicular sides in both margins, and which shield the rocky hills on either bank. A thin bed of vegetable mould, the result of decomposition, or perhaps aided by occasional overflows of the stream, caps the alluvium; but the latter is distinctly a formation antecedent to the birth of the river. Of all problems referring more immediately to Indian geology, this appears to me the most interesting; whether we regard this vast deposit in a purely geological light or as that depression of hills and elevation of valleys, which has smoothed so much of the surface of the continent from the Himalayah to Cape Comorin, producing uniformity of outline and of concomitant features, over many thousands of square leagues, favoring the ravages of conquering races, and the propagation of creeds, of populations and industrial arts. On passing over the mountainous districts one is astonished at the isolation of the tribes, inhabiting the rugged hills of Curruck from Parus Nath and Rajmahal, but a uniformity prevails amongst the people north of the range, and along the Gangetic plains, from Benares to Monghyr, more marked than between any two neighbouring counties in England.

To return to the Parus Nath range (or table-land of north Bengal) it is the great water bed of this part of India. Rivers flow from it N. W. and N. into the Soane; the Rheru, the Kunner, the Coyle and innumerable smaller streams. A few insignificant nullahs also find their way to the Ganges. The more considerable ones debouche in the Hooghly, as the Dummoodah with its affluents, the Adji and Barrucker, the Cossye and Dalkissori; and still others, the Subunrika, Brahminy and north feeders of the Mahanuddy flow to the Bay of Bengal.

Hence, though difficult to define from its gradual slope to the eastward, its broken outline, (so different from the ghat ranges of sandstone or trap rocks,) and from the impracticable nature of the country forming its southern boundary, it is a range of great interest, from its being the source of so many important rivers, and of all those which drain the country between the Soane, Hooghly and Ganges—from its position directing the course of the Soane and forcing the Ganges which strikes its base at Rajmahal, to seek a sinuous course to the sea. In its climate and botany it differs equally from the Gangetic plains to the north and from the hot damp and exuberant forests of Orissa to the south. Nor are its geological features less different, or its concomitant and in part resultant characters of agriculture and native population. Still further west than Mainpath, this range is continued, probably ascending, till it meets the Vyndhya at Omer-kuntuk, there the great rivers of the peninsula have their origin, these two ranges meeting and combining to throw of the waters mainly in opposite directions. The Nerbudda and Taptee hence flow west to the gulf of Cambay, the Cane to the Jumna, the Soane to the Ganges, and the northern feeders of the Godavery to the Bay of Bengal. Further west it appears to me that they again separate, but are still to be recognized by geological features, though these are masked by the presence in common to both of enormous overlying masses of trap.*

February 12*th*.—Left Sheergotty (alt. 463 ft.) crossing some small streams which, like all else seen since leaving Dunwah Pass, flow N. to the Ganges. Long low ranges of hills, isolated, and together forming no apparent system, rise abruptly out of the plain. These are chiefly of volcanic rocks, syenite and greenstone, forcing up, and sometimes injected through broken masses of gneiss, metamorphic quartz, hornstone, &c. All the rocks composing them are of excessive hardness and covered with a scanty vegetation, approaching absolute sterility. Many of them occurring between Sheergotty and the Soane, are better known to the traveller from having been telegraphic stations. Some are much impregnated with iron, and whether for their color, the curious outlines of many, or their position, they form quaint, and in some cases picturesque features in the otherwise tame landscape.

At Muddunpore alt. 442† ft. a thermometer, sunk 3 ft. 4 inches in

* I laid these views when very crude before my friend and present host B. H. Hodgson, Esq. and received such assistance in fixing them as few could afford. I am anxious, thus early, to record my deep sense of obligation to one who is my master in the Physical Geography of Asia, because, living as we are in constant intercourse, and entertaining views, so consonant on enquiries of this nature, the pupil is apt to forget, how much the results of his own efforts are enhanced in value by the directing hand of his preceptor.

† I need hardly say that I hope for the indulgence of the Indian Geographer during his perusal of this sketch. It is given with the view of eliciting contradiction or confirmation, and perhaps with too much of that confidence which my superficial knowledge of a great part of the country in question inspires. One end will have

the soil maintained a constant temperature of 71.5°, that of the air varying from 77.5 at 3 P. M. to 62. at sunrise.

Road to Nourunga highly cultivated, with the *Phœnix* more abundant, and many of the weeds of the cultivated grounds, the analogues of the corn-field plants of England, and in many cases the same genera, and almost universally belonging to the same natural order, as *Labiatæ, Scrophularinæ, Solaneæ, Leguminosæ,* and *Boragineæ, Caryophylleæ, Veronica, Anagallis* and *Graphalium luteo-album;* both the latter very prevalent European weeds, were abundant, and are amongst the few English plants common to India. The ground in some places was spangled with the blue flowers of the beautiful *Exacum tetragonum?* as English upland meadows are often with its ally *Gentiana campestris.* At 312 milestone the elevation of the road from one morning observation is 371 ft.

At Nourunga I sunk two Thermometers in partial shade of Palms. One at 3 ft. 8 in., the other at 4 ft. 8 in., with the following results:

Time & Temp. of Air.	*Shade.*	at 3 ft. 8.	at 4 ft. 8.	Temp. at 3 P. M.
Feb. 13th, 9 P. M.	60	71.0	71.5.	of the same day 71°
10 P. M.	60	72.0	72.0.	Maxm. of bk. bulb
14th, 5 A. M.	57	70.	71.5.	Thermometer 119°.

At 5 A. M. I took the temperature of the earth at lesser depths.

Surface soil,	53
1 Inch.	57
2 ,,	58
4 ,,	62
7 ,,	64

The elevation of Naurunga is 342 feet, and the soil bored into, was an excessively tough alluvium which however seemed to part with its heat from nocturnal radiation very rapidly. The three observations at 3 feet 8. and 4 feet 8.

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been served should it lead other travellers and enquirers to group geographical features. A stranger in India is overwhelmed with local details. In no British possession have I found a community so conversant with the local geography of that whole country, of which each individual can see but little; none where a new comer may accumulate information so rapidly, so accurately, and I may add without flattery, so pleasantly. But still the broad features are neglected, the dependence and direction of the rivers upon the elevation and disposition of the land, the connection of those with geographical phenomena, of more remarkable simplicity in India than in any similarly extensive country, and the possibility of arranging a knowledge of details by a due regard to the bearings of all these. Very many can indicate with precision the position of an untold number of towns and the mouths of as many rivers, but how few will point the finger to Omer-kuntuk if asked for the fountain-head of all the great cis-Himalayan streams, though these span an area of 10 degrees of latitude and 16 in longitude.

are not sufficient to draw any conclusions from, but they appear to indicate the transmission of solar heat accumulated during the day downwards, between 9 P. M. and sunrise of the following morning.

February 14th.—Marched from Naurunga to Barroon on the Soane, crossing several streams, one deep. It is curious that all the streams between the Dunwah pass and the Soane itself run parallel to that river and into the Ganges, even the westernmost of them, as the Pompon, some of whose feeders at the great trunk road, run parallel to the Soane, within a mile of that river, but instead of finding their way to it, seek a northward course of nearly 100 miles to the Ganges. This indicates a more rapid fall of the land towards the N. than to the W., and further, a depression between Dunwah and the Soane, which I believe occurs about Naurunga, and from whence there is a rise towards the Soane. Nothing can more clearly indicate the tenacity and durability of the alluvium through which the small streams wind their way. The body of water lodged in this depression would else, during the rains, find a course into the Soane, instead of keeping parallel to it for so many miles. The fall of the Soane itself however gives the northerly dip of the land towards the Ganges more clearly. My observations both at Barroon on the E. and at Dearee on the W. bank (opposite) of the Soane, makes the river here about the same level as that of the Ganges at Benares, which Prinsep estimates at 300 feet above Calcutta. Now the length of the Ganges between Benares and the mouth of the Soane is about 150 miles, with a fall of as many feet. The length of the Soane between Barroon and the Ganges is 70 miles with a fall of upwards of 150 feet,* producing of course a current most unfavorable to navigation.

Barroon is situated on the alluvial bank of the river (elevated 345 feet) and on as naked and barren a looking country as well may be, the broad expanse of sand which the river exposes in the dry season, resembles a desert, which like many other similar expanses of sand on the Ganges, has its mirages, its simooms, and the other phenomena of an

* All these elevations are above the sea, must be considered as mere approximations, and are intended to give the general outline of the land. Had I detailed surveys of the countries in question, they would of course have been preferred to my own very rough geodetical operations, and which were not taken with the view of determining levels primarily.

Australian or African desert to a miniature. Its surface in the day is heated above that of the neighbouring country, at night cooled below it. The stars appeared to twinkle more clearly on its banks, and I thought I could during the early morning detect a current of air flowing from its cooled atmosphere to that surrounding the warmer alluvial plains. *Rhamneæ, Carissa, Olax, Acacia, Menispermun* and a tall stiff and dry *Malva*, formed the pervailing vegetation, with *Cuscuta, Cassytha*, a few *Asclepiadeæ* and withered grass. Though this is the coldest season, the sand was heated to 110° and upwards where sheltered from the wind, and to 104° on the broad bed of the river.

To compare the rapidity and depth to which the heat is communicated by pure sand, and by the tough alluvium, I took the temperature at some inches depth in both. The mean of a good many observations at different holes, gave the following differences between the temperature of a column of sand in situ 16 inches thick, at 2 P. M. and 5 A. M. the following morning.

Feb. 14th 2 P. M.		15th, 5 A. M.	Diff.
Air in shade,	81°	62	18°
Surface,	108	43	64.5
$1\frac{1}{2}$ inch, . .	100	50	50
$3\frac{1}{2}$,,	85	57	28
6 ,,	73	67	6
16*	72*	68	4

* Sand wet at this depth.

Maximum of black-bulb therm. during the day 126°. Min. of radiation at 5 A. M. from a naked bulb therm. 48.2. (exposed over the sand).

That the alluvium both conducts the heat better, and retains it longer, would appear from the following, the only observations I could make owing to the tenacity of the soil.*

Hard alluvial bank of river.

2 P. M. Surface 104°.
$2\frac{1}{2}$ inch, 93°.
5 ,, 88°. Sand at this depth, 78°.
5 A. M. Surface 51°.
28 inches, 68°.5.

* The plan I adopted was suddenly to remove a large clod of alluvium and insert a very small thermometer bulb into a perpendicular side of the hole thus made. I should be glad that any one could suggest to me a better method, feasible for a traveller. The increment or decrement of heat is so rapid for a few inches below the surface as to render its determination with any accuracy very difficult.

Hence the difference between the heat of the surface of the alluvium and of the same at 5 inches is, 16° during the day, but of a similarly disposed column of sand, 30°.

During the night again a column of 28 inches of alluvium presents a difference of 17°.5, one of sand as nearly as I could ascertain of 16 inches, 24°.5.

This effect of sandy deserts in causing extremes of heat during the day, and cold at night, is thus readily to be apprehended, and in the case of the larger area covered with sand, the effect of radiation is probably much increased. Thus in the desert between Cairo and Suez a surface heated in the middle of December to 90° during the day, presented on the following morning, before sunrise, a dewed surface of 47o.5, the increment of heat in digging down to 10 inches was 9 degrees: so powerful is then the effect of nocturnal radiation, that a column of 10 inches was cooled at its base to within 9 degrees of its exposed surface; while a similar one on the Soane had its base temperature 24° above that of the surface, &c.

Observing the flowing sap of a vigorous *Calotropis* plant growing in the sand to maintain a temperature of 72° in spite of the great heat of the surrounding soil, I dug about its roots and obtained that temperature at 78 inches where the sand was wet, and from whence its roots derived their moisture. As at 15 inches the temperature was still only 72° and its roots did not appear to descend so deep, it is evident that the plant was pumping up moisture with such rapidity as to bring the fluid to the surface as cool as below. That this coolness of the sap is due to the ascending currents, is proved by taking the temperature of the leaves, which were at 80° (constants).

The low temperature of the leaves exposed to the sun (which heated the sand to 110° and earth to 104°) is probably due both to the coolness of the ascending sap and evaporation from the leaf's surface, as the activity of the circulation is regulated by the rapidity of evaporation. On the same night the leaves were cooled to 54° by radiation, the sand to 51°, and before sunrise on the following morning the *Calotropis* showed 45°.5 and the sand 42°. I neglected to observe the temperature of the sap at this time, but supposing it to be that of the earth at the same depth (15 inches) which was 68°, we must admit the leaves to be heated only 8° by solar radiation and cooled 22°.5 by nocturnal.

Two thermometers sunk in the alluvium here gave the following results:—

The air.	Soil at 3 ft. 6.	Soil at 2 ft. 4.	In both cases
9 P. M. 62°	70°	70°	perfectly ex-
11 P. M.	72	72	posed hard al-
$5\frac{1}{2}$ A. M. 53.5.	48.5.	68.5.	luvial soil.

Here again, as at Nourunga, there is a decided increase of temperature after 9 P. M. I cannot suppose however, that it is due to a heating of the soil to that depth, so rapidly as the 9 and 11 o'clock observations would seem to indicate.

February 15th.—Crossed the Soane to Dearee on the opposite bank; at this season there is but little water and the body of the current runs close to the W. shore; all else is sand, representing in its major and minor undulations those of the ocean. The progressive motion of the waves was very evident, and produced by the sand from windward flying off one ripple and heaping against the weather bank of the ripple to leeward; thus though the particles of sand preserve an onward course, the waves are advancing against the wind or retrograding, that in front being added to on its weather side. A few islets of laminated sand occur in the bed of the sand, little oases, green with waving crops of much diseased wheat and barley. Alt. of Dearee 334 ft.

February 16th.—From hence our course lay up the Soane, leaving the grand trunk road. Marched from Dearee this morning to Tilothi, through a rich and highly cultivated country, covered with indigo, cotton, sugar-cane, *Carthamus,* castor oil, poppy, and various grains. The *Zizyphi* are larger, *Cuscutas* cover even tall trees with a golden web, and the *Capparis acuminata,* was in full flower along the road side. Tilothi, a beautiful village situated in a magnificent tope, is close to the river, and about 5 miles from the foot of the Kymaon, which here presents a precipitate sandstone escarpment. The plants along its base were precisely the same as those of the Dunwah pass, and on their tops those of the base of Parus Nath: *Buchanania, Boswellia, Terminalias, Acacias, Bauhinia* and the white-trunked naked-armed *Sterculia fœtidissima.*

A hole was sunk here again, for the thermometers, and as usual, with great labour; 8 men took as many hours to bore 5 ft. with a very heavy iron *jumper,* so exceedingly tough is the soil;—the temperatures obtained were—

Air.	4 feet 6 inches under good shade of trees.
9 P. M. 64°5	77°
11 P. M.	76°
$5\frac{1}{2}$ A. M. 58°5	76°

This is a very great rise (of 4°) above any of those previously obtained, and certainly indicates a much higher mean temperature of the locality. I can only suppose it due to the radiation of heat from the long range of sandstone cliff, exposed to the south, which overlooks the flat whereon we were encamped, and which though 4 or 5 miles off, forms a very important feature. The differences of temperature in the shade taken on this and the other side of the river are 2°8 higher on this side.

February 17th.—Proceeded up the Soane to Rotasghur, where a spur of the Vindhya stands abruptly forward.

The range, in proceeding up the Soane valley gradually approaches the river, and beds of limestone are seen protruding below the sandstone and occasionally rising into rounded hills, the paths upon which show as white as do those through the chalk districts of England. The overlying beds of sandstone are nearly horizontal, or with a dip to the N. W.; the subjacent ones of limestone dip at a greater angle. Before coming to the village of Akbarpore, at the base of the spur, the road passes over the foot of a curious detached conical hill of limestone, capped with a flat mass of sandstone, whose edges, from the more rapid decomposition of the subjacent support, overhung the top of the hill. At its base the beds of some are undulating and an anticlinal line is passed over; beyond this the escarpment of the Vindhya sweeps backwards from the river, and returns as the spur of Rotas, which thus forms one horn to a grand amphitheatre of rocks, enclosing a wooded valley. The forest creeps up the sloping base of the precipices, whose crests are shaggy also with a rough jungly wood. This view of the conical hill with its sandstone cap, the grand sweep of the scarped rocks, returning to form the fortress-crowned spur of Rotas, and the foreground of wooded valley, is exceedingly fine.

During my stay at Akbarpore we had the advantage of the society of C. E. Davies, Esq. who was our guide and instructor during some rambles in the neighbourhood, and to whose experience, founded on the best habits of observation, I am indebted for excellent information. On our excursion to the top of the hills, we passed one of those beautiful built wells, about 60 ft. deep, and with a fine flight of steps to the bottom. Now neglected and overgrown with flowering weeds and creepers, it afforded me many of the plants I had only previously obtained in a withered state; it was curious to observe there some of the species of the hill tops, whose seeds doubtless are scattered abundantly over the surrounding plains, and only here find a congenial climate, where the coolness and moisture of their natural level are imitated. A fine fig tree growing out of the stone work spread its leafy green branches over the well mouth, which was about 12 ft. square; its roots assumed a singular form, enveloping two sides of the well walls, with a beautiful network, which at *high-water mark,* (rainy season) abruptly divides into thousands of little brushes, dipping into the water which they fringe, thence descending to the earth below. It was a pretty cool place to descend to, from a temperature of 80° above, to 74° at the bottom, where the water was 60°; and most refreshing to look, either up the shaft to the green fig shadowing the deep profound, or along the sloping steps through a vista of flowering herbs and climbing plants, to the blue heaven of a burning sky.

The ascent to Rotas is over the dry hills of limestone, covered with a scrubby brush-wood, to a crest where are the first rude and now ruined defences of the pass. The limestone is succeeded by the sandstone cliff cut into steps, which leads from ledge to ledge of the strata, and gap to gap, well guarded with walls and archways of solid masonry. Through this you pass on the flat summit of the Kymaon hills, covered with grass and low loose forest, amongst which paths run in all directions. The ascent is about 1200 ft. a long pull in the blazing sun, even of February. The turf is chiefly of spear-grass and *Nardus,* which yields the favorite oil, much used in domestic medicine all over India. The trees are of the kinds mentioned before, especially the *Olibanum, Wrightea, Diospyros* and *Terminalia;* the Sal *(Vatica robusta)* is rare, from being universally cut down. The curious *Hymenodyctium thyrsiflorum* grows as a scattered tree. A pretty octagonal summer-house with a roof supported by pillars, occupies one of the highest points of the plateau; it is called 1485 ft. above the Soane, and commands a superb view of the features mentioned before.

From this to the palace is a walk of 3 miles, through the woods.

The buildings are very extensive, and though now ruinous, bear evidence of great beauty in the architecture: light galleries supported by slender columns, long cool arcades, screened squares and terraced walks, are the principal features. The rooms open out into flat roofs, commanding views of the long endless table-land on one side, and a sheer precipice of 1000 feet on the other, with the Soane, the amphitheatre of hills, and village of Akbarpore, below.

This and Bidjegur, higher up the Soane, were some of the most recently reduced forts, and this was further the last of those wrested from Baber in 1542. Some of the rooms are still habitable, but the greater part are ruinous and covered with climbers of both wild flowers, and the naturalized garden plants of the adjoining shrubbery. The *Nyctanthes* and *Guettarda,* with *Vitex negundo, Hibiscus abelmoschus, Abutilon indicum, Physalis, Justicia adhatoda* and other *Acanthaceæ,* and above all the little yellow-flowered *Linaria ramossima,* crawling like the English *L. cymbalaria* over every ruined wall: all this is just as we see the walls of our old English castles harbouring to the last the plants their old masters fostered in the garden hard by.

On the limestone walls several species of crustaceous *Lichens* abounded.

In the old dark stables I observed the soil to be covered with a copious most evanescent efflorescence, apparently of Nitrate Lime, like soap-suds scattered about.

I made Rotas Palace 1576 feet above the sea, or 1177 feet above the village, so that this table-land is here only 50 feet higher than that I had crossed on the Grand Trunk Road, before descending at the Dunwah pass. Its mean temperature Mr. Davies informs me, is probably about 10° below that of the valley below, but, though so cool, not exempt from agues after the rains. The extremes of temperature are less marked up here than below, where the valley becomes excessively heated, and where the hot wind sometimes lasts for a week, blowing in furious gusts.

The climate of the whole neighbourhood has changed materially; and the fall of rain, which has much diminished, consequently on felling the forests; even within 6 years the hail-storms are far less frequent and violent. The air on the hills is highly electrical, owing no doubt to the dryness of the atmosphere, and to this the frequent formation of hail-storms may be due.

The Zoology of these regions is tolerably copious, but little is known of the natural history of a great part of the plateau; a native tribe, prone to human sacrifices, is talked of. Tigers are far from unfrequent, and bears numerous, they have besides the leopard, panther, viverine cat, and civet. Of the dog tribe the pariah, jackal, fox, and wild dog called Koa. Deer are very numerous, of 6 or 7 species. A small alligator inhabits the hill streams, a very different animal from either of the Soane species.*

During our descent we examined several instances of ripple mark in the sandstoue; they resembled the fluting of the *Sigillaria* stems, in the coal-measures, and occurring as they did here, in sandstone a little above great beds of limestone, had been takeu for such, and as indications of coal.

On the following day we visited Rajghat, a steep ghat or pass up the cliff to Rotas Palace, a little higher up the river. We took the elephants to the mouth of the glen, picking up Mr. Davies in our way, who had taken his *usual* before break-fast walk, of from Akbarpore to the top of Rotas! and down by the Rajghat pass. Dismounting we followed a stream abouuding in small fish and aquatic insects, *(Dytisa* aud *Gyrini)*, through a close jungle, to the foot of the cliffs, where there are indications of coal. The woods were full of monkeys, and amongst other plants I observed *Murraya exotica*, but scarce. Though the jungle was so dense the woods were very dry, uo Palm, *Aroideæ*, Peppers, *Orchideæ* or Ferns. Here, at the foot of the cliffs, which towered imposingly above as seen through the tree tops, are several small seams of coaly matter in the sandstoue, with abundance of pyrites, sulphur and copious efflorescences of salts of iron: but no real coal. The springs from the cliffs above, are charged with lime, of which enormous tuff beds are deposited on the sandstone, full of impressious of leaves and stems of the surrounding vegetatiou. In some part of their course the streams take up quantities of the efflorescence, which are scattered over the sandstones in a singular mauuer.

At Akbarpore (alt. 399 ft.) I had sunk two thermometers, one at the depth of 4 feet 6 iuches, the other 5 feet 6 inches, which both indicated 76° during the whole time of my stay, the air varying at the surface

* For the better part of this information and much other of value, whose insertion would cause this paper to exceed its proper limits, I am indebted to Mr. Davies.

from 56° to 79°.5. Dew has been formed every night on the plains since leaving the hill at Dunwah, the grass being here cooled 12° below the temperature of the air.

February 19*th*.—Marched up the Soane to Tura, passing some low hills of limestone, between the cliffs of the Kymaon and the river. Collected *Ulmus integrifolia,* a small *Clerodendron,* and pretty bell-flowered Asclepiadeous plant crawling over the hedges. Botanized on the banks of the river, which is lined with small trees of *Ficus, Terminalia, Phyllanthus, Trophis,* and various shrubs, one, a very sweet-scented Vitex, with clusters of white flowers, also *V. agnus-castus?* (or Negundo.) On the shaded banks, abundance of a *Myosotes* like *Cynoglossum, Veronicæ, Potentilla, Ranunculus sceleratus, Ramex,* several herbaceous *Compositæ* and *Labiatæ; Tamarix* formed a small bush in rocky hillocks in the bed of the river, and in pools several aquatic plants, *Zanichellia, Naias, Chara,* and a pretty little *Vallisneria,* and *Potamogeton. Riccia* was very abundant. The Brahminy goose was common here, and we usually saw in the mornings immense flocks of wild geese overhead, flying. North elevation of Tura 443 ft.

Here I tried again the effect of solar and nocturnal radiation on the sand, at different depths in the sand, not being able to do so on the alluvium. Temperature of air 87°.

	Noon.		Daylight of following morning.
Surface*	110°		52°
1 inch	102°		55°
2 ditto	93°5		58°
4 ditto	84°		67°
8 ditto	77°	Sand wet	73° wet
16 ditto	76°	ditto	74°

As from above Tura the Soane valley narrows very rapidly, I shall give here an abstract of the Meteorological observations taken since leaving the Dunwah Pass.

The difference in mean temperature, (partly owing to the sun's approach) amounts to 2°5 of increase on the Soane valley, above that of the hills. The range of the thermometer from day to day was considerably greater in the upper station (though fewer observations were

* Thermometer employed not registered above this temperature.

there recorded) amounting to 17.2 in the former and only 12°8 in the lower station. The range from the maximum to the minimum of each day amounts to the same in both, above 20°. The extreme variations in temperature too coincide within 1°4.

In the hygrometric state of the atmosphere, this of the plains differs most decidedly from that of the hills. Here, as I remarked, dew is constantly formed, which is owing to the amount of moisture in the air, for nocturnal radiation is more powerful on the hills, though it never caused a thermometer to descend to the dew point there. The sunrise and 9 p. m. observation on the lower level give a mean depression of the D. P. below the air of 12°.3, and those at the upper level of 21°.2, with no dew in the former case and a copious deposit in the latter. The corresponding state of the atmosphere as to saturation is 0.480 on the hills and 0.626 below. The only causes I can assign for this seem hardly sufficient: they are the more uniform depth and presence of the alluvium and the frequency of rivers; and what perhaps is even more powerful the shelter afforded by the Kymaon hills from the dry N. W. winds; though it is difficult to conceive that hills of only 1000 feet elevation can influence much a valley 80 miles broad (between the Kymaon and Dunwah.)

The vegetation of the Soane valley is exposed to less extremes of temperature, than that of the hills. The difference between solar and nocturnal radiation amounting here only to 80°.5, and in the former case to 96°.5. There is no material difference in the power of the sun's rays at the upper and lower level, as expressed by the black bulb thermometer, the average rise of a thermometer so exposed over one in the shade, amounting to 48° in either case, and the maximum occurring about 11 a. m. The decrease of the power of the sun's rays in the afternoon is much the most rapid in the valley, coinciding with a greater reduction of the elasticity of vapor and of humidity in the atmosphere.

The photometric experiments show a greater degree of sun's light on the hills than below, but there is not in either state a decided relation between the indications of this instrument and the black bulb thermometer. From observations taken elsewhere I am inclined to attribute the excess of solar light on the hills to their elevation; for at a far greater elevation I have met with much stronger solar light, in a very damp atmosphere, than I ever experienced in the drier plains of India. In a damp climate the greatest intensity may be expected in the forenoon, where the vapor forms a thin and uniform stratum near the earth's surface; in the afternoon the lower strata of atmosphere are drier but the vapor is condensed into clouds aloft which more effectually obstruct the sun's rays. On the Birbhoom and Behar hills, where the amount of vapor is so small that the afternoon is but little drier than the forenoon, there is little difference between the solar light at each time. In the Soane valley again, where a great deal of humidity is removed from the earth's surface and suspended aloft, the obstruction of the sun's light is very marked.

I have given a few observations on the temperatures of the leaves of two plants during the night, *Argemone Mexicana* and *Calotropis procera,* to which I shall allude when more shall have been taken.

Dunwah to Soane River, and up Soane to Tura, Feby. 10th-19th.

	Temperature.				Wet. Bulb.			Elasticity of Vapor.	Dew Point.					Weight of Vapor in cubic feet.	S. Saturation.			Number of observations.
	Mean.	Max.	Min.	Range.	Mean.	Max. Depression.	Min. Depression.		Mean.	Max.	Min.	Max. Depression.	Min. Depression.		Mean.	Max.	Min.	
Sunrise,	57.6	62.0	53.5	8.5	51.7	8.5	3.8	0.352	46.1	53.6	40.6	16.9	7.0	3.930	.680	.787	.566	10
9 A. M....	74.0	81.0	63.5	17.5	59.5	18.5	4.0	0.382	48.5	56.7	38.0	33.5	6.8	4.066	.460	.818	.338	8
3 P. M.....	77.6	87.5	71.0	16.5	59.9	26.0	6.8	0.357	46.4	60.0	36.0	44.2	11.0	3.658	.352	.703	.237	9
9 P. M.....	64.5	68.7	60.0	8.7	55.5	12.5	2.5	0.370	47.5	55.6	41.0	24.1	4.4	4.014	.572	.860	.452	10

Extreme variation of Temperature.................. = 34.0°

,, ,, ,, Saturation .... = .623

,, diff. between Solar and Nocturnal Radiation = 80.5

Dunwah to Tura.
Nocturnal Radiation.

	Sun-rise.				9 p. m.			
	Temperature.	Mean Diff. from Air.	Max. Diff. from Air.	Number of observations.	Temperature.	Mean Diff. from Air.	Max. Diff. from Air.	Number of observations.
Exposed Th.	53.2	4.5	8.5	9	59.9	4.6	11.5	10
On Earth, ..	54.0	3.7	9.0	9	60.7	3.8	10.5	10
On Grass, ..	51.5	6.2	7.5	8	56.4	8.1	13.5	10

Dunwah to Tura.
Solar Radiation.

Morning.					Afternoon.				
Time.	Temp.	Black bulb.	Diff.	Phot.	Time.	Temp.	Black bulb.	Diff.	Phot.
9 p. m.	70.0	125	55.0	10.300	4 p. m.	76.5	90	13.5	..
11......	81.0	119	38.0	10.230	3	80.0	105	25.0	10.210
10½	71.5	126	54.5	10.300	3	76.0	102	26 0	10.170
10......	72.0	117	45.0	10.220	3	87.5	126	38.5	..
10......	80.0	122	42.0	..	..	..	..	..	..
10½	78.0	128	50 0	..	..	..	..	..	..
Mean ..	75.4	122 8	47.4	10.262	..	80.0	105.7	25.7	10.190

Dunwah to Tura.
Nocturnal radiation from plants.

Sun-rise.					9 p. m.				
Air Temp. ..	Calotropis.	Diff.	Argemone.	Diff.	Temp.	Calotropis.	Diff.	Argemone.	Diff.
59.5	..	..	57.0	2.5	67.5	..	..	53.0	14.0
55.0	49.5	5.5	47.	8.0	67.	..	..	56.0	11.0
					64.3	58.5	5.8	57.0	7.3

February 20th.—From Tura we have again to cross our little army over the Soane, the Kymaon cliff approaching too near the river on this (W.) side, to allow of our passing along their base.

The river bed is very sandy, and about 1½ mile across (apparently). I found the male *Vallisneria* flowers after a great search; it is impossible to distinguish them from the gnat's eggs, with which the pools swarm.

The stream was very narrow, but deep and rapid, obstructed with beds of coarse agate, jasper and chalcedony pebbles. A clumsy boat, here took us across to the village of Dumersolah (or Soanpore) a wretched collection of hovels. The crops thin and poor, and no palms or good trees. Squirrels however abounded, and were busy storing; descending from the trees they scoured across a road to a field of tares, mounted the hedge, took an observation, foraged and returned up the tree with their booty, quickly descended and repeated the operation of reconnoitering and plundering.

The bed of the river here is considerably above that at Dearce, where the mean of the observations with those of Barroon made it about 300 ft. The mean of these taken here and on the opposite side, at Tura, gives about 420 feet, indicating a fall of 120 feet in only 40 miles. Near this the sandy banks of the Soane are full of martins' nests, each one containing a pair of eggs. The deserted ones are literally crammed full of long-legged spiders, (Phalangium) which may be raked out with a stick and come pouring down the cliff like corn from a sack; the quantities are quite inconceiveable. I did not observe the martin feed on them.

The entomology here resembled that of Europe, more than I had expected in a tropical country, where predacious beetles, at least *Carabildeæ* and *Staphylinideæ* are generally considered rare.

The latter tribes here swarmed under the clods, of many species too, but all small, and so singularly active that I could not give the time to collect well. In the banks again, the round egg-like earthy chrysalis of the *Sphinx Atropos?* and the many-celled nidus of the leaf-cutter bee were most common.

A large *Euphorbia (E. ligulata?)* is common all along the Soane and used every where (since leaving Dunwah) for fencing. I have not seen the *E. Indica;* and the *E. tereticaulis* very rarely since leaving Calcutta. The *Cactus* is nowhere here.

From this place onwards up the Soane, there is no road of any kind, and we must be our own road engineers. The sameness of the vegetation, and lateness of the season made me regret this; having expected both luxuriance and novelty in these seldom visited and never botanized wilds. Before us the valley narrows considerably, the forest becomes denser, the country in the S. side broken with rounded hills, and on the N. the noble cliffs of the Kymaon dip down to the river. The villages are smaller, more scattered and poverty-stricken, with the Mahowa and Mango as the usual trees: the Bangar, Peepul, and Tamarind being rare. The natives look more of a jungle race, are tall, athletic, erect, much less indolent and more spirited than the flat and listless natives of the plains.

February 21st.—Started at day-light: but so slowly and with such difficulty, through field and wood, and across deep gorges from the hills, that we only advanced five miles in the day, the elephant's head too was aching too badly to push, and the cattle will not advance when the draught is not equal. What is worse, it is impossible to get them to pull together up the inclined planes we cut, except by placing a man at the head of each of the 6, 8, or 10 in a team, and playing at *screwtail;* when the obstinate animal sometimes capsizes the vehicle. The small garrys and hackeries got on better, though it was most nervous to see them rushing down the steeps, especially those with our fragile instruments, &c.

Kosderah, where we halted, is a pretty place, elevated 473 feet, with a broad stream from the hills flowing past it. These hills are of limestone, and rounded, resting upon others of hornstone and jasper.

The camp was pitched by three small trees of Paper mulberry (I take it) which I had not seen before, and are scarce here.

Following up the little stream, gathered two species of *Potamogeton* and the *Vallisneria*, the latter forming an elegant green carpet in very rapid water, the corkscrew stems always on the stretch. Two *Æschynomynes* abounded, with a *Jussieva, Cyperus,* and several grasses. At the rapids the stream is crossed by large beds of hornstone and porphyry rocks, excessively hard, and pitched up at right angles, or with a bold dip to the N. The number of strata was very great, and of only a few inches or even lines thick; they presented all varieties of jasper, flint-rock, hornstone and quartz of various colours, with occasionally seams of porphyry and Breccia. Hills of these rocks, and similarly heaved up, skirt the granite range of Parus Nath from the Ganges to as high up the Soane as we went, and perfectly similar rocks occurred again on the Ganges, at the N. of the same range in the islet rocks of Monghyr, Colgong and Sultanpore; they appear to form a deep bed, overlying the gneiss and granite above mentioned, and to be thrown up by the great range.

The numberless little rocks of the rapids were elegantly fringed with a fern I had not hitherto seen, probably *Polypodium proliferum,* and which is the ouly species the Soane valley presents at this season.

Returning over the hills, found the *Boswellia, Gmelina parviflora,* with the common trees of the heights, also *Hardwickia linata,* a most elegant leguminous tree, tall, erect, with an elongated coma and the ultimate ramuli pendulous, covered with bipartite leaves.

All the hills were covered with a shallow bed of alluvium, enclosing abundance of agate pebbles and kunker, the former derived from the quartzy strata above noticed.

At night the fires on the Kymaon hills blazed splendidly, the flames in some places leaping from hill to hill. In front of us a gigantic letter W. is written in fire.

February 23rd.—Start at daylight, moving the camp up the river with great difficulty to Panchadurmah (elev. 492 feet). High N. W. (the prevailing) wind generally commences at or before sunrise, and moderates at sun-down: this in the narrowed valley blows with very great force, and is so loaded with dust that the hills close by are often obscured: on their subsiding the atmosphere clears remarkably suddenly.

February 24th.—Following up the Soane to Pepurah, (elev. 517 ft.) the country wooded, very wild and picturesque; the Mahoowa tree and *Cedrela, Nauclea, Hardwickia* very abundant with *Terminalias, Pentapteris, Pongamia, Ehretia lævis,* a small tree, covered with white blossoms, and the new foliage deep green, shining and viscid. A fine *Strychnos* forms a dense foliaged tree, 30—60 feet high, some pale yellow, as if dying, others deep green, both in apparent health. *Feronia Elephantum* and *Ægle marmelos* very abundant, with various *Leguminous* and *Rubiaceous* trees; *Sterculia* and the dwarf *Phœnix,* which I have never found in fruit or indeed in flower except at Dunwah. Peacocks abound in the woods, and monkeys.

One of my garrys is broken hopelessly and advancing on the spokes instead of the tyre of the wheels. By the banks of a deep gulley here the rocks are well exposed, of shales resting on the limestone, which is nearly horizontal; and this again, unconformably on the quartz and hornstone rocks, which are confused and tilted up at all angles. In one place I observed the strata of the latter to run horizontally for a few feet, and suddenly to be turned up at right angles; with an arc less than a foot in span.

A spur of the Kymaon, like that of Rotas, here projects to the bed of the river, flaming at night with beacon-like fires of the natives, lighted to scare the tigers and bears from the spot where they cut wood and bamboo. The night was bright and clear, with much lightning, the latter attracted to the spur, and darting down as it were to mingle its flame with that of the forest; so many flashes appeared to strike on the flames, that it is probably the rarified air in their neighbourhood attracted it.

February 25th.—Awakened between 3 and 4 by a violent dust storm which threatened to carry away the tents. Our position at the mouth of the gulley, formed by the opposite hills, no doubt accounts for it. The gusts were so furious that it was impossible to observe the barometer, which I returned to its case on ascertaining that any indications of a rise or fall, in the column must have been quite trifling.

The night had been oppressively hot, with many insects flying about; amongst which I noticed a *Forficula*, a genus so rarely known to take to the wing in Britain.

At $8\frac{1}{2}$ A. M. it suddenly fell calm, and we proceeded to Chahnchee (elev. 482 feet), the native carts breaking down in the passage over the projecting beds of flinty rocks, or as they hurried down the inclined planes we cut through the precipitous banks of the streams. Near Chahnchee passed an alligator, just killed by two men, a foul beast, about 9 feet long, of the Mager kind. More absorbing than its natural history was the circumstance of its having swallowed a child, that was playing in the water as its mother was washing her utensils in the river. The brute was hardly dead, much distended by the prey, and the mother standing beside it. A very touching group was this: the parent with her hands clasped in agony, unable to withdraw her eyes from the cursed reptile, which still clung to life with that tenacity for which its tribe are so conspicuous; beside these the two athletes leaned on the bloody bamboo staffs, with which they had all but despatched the animal.

The *Butea frondosa* is abundantly in flowers here, and a gorgeous sight. In mass the inflorescence resembles sheets of flame, and individually the flowers are eminently beautiful, the bright orange red petals contrasting brilliantly against the jet-black velvety calyx.

By the river found two species of *Gnaphalium, Paronychia, Tamarix,* a dwarf *Acacia* like *Phyllanthus, Wahlenbergia, Campanulæ, Lepidium, Sagitalia? Vallisneria* and Docks (*Rumex Wallichii*) in abundance. Cumin and many other herbaceous plants; tortoises are frequent on the rocks, but pop into the water as approached.

The nest of the *Megachile* (leaf-cutter bee) was in thousands in the cliffs, with *Ephemeras, Caddis worms,* spiders and many predaceous beetles. Lamellicorn beetles are very rare, even *Aphodius,* and of *Cetoniæ* I did not see one.

The poor woman who lost her child earns a scanty maintenance by making catechu; she inhabits a little cottage, and has no property but two cattle to bring wood from the hills, and a very few household chattles, and how few of these they only know best who have seen the meagre furniture of Dangha hovels. Her husband cuts the trees in the forest and drags them to the hut, but he is now sick and her only boy, her future stay it was whose end I have just related. Her daily food is rice, with beans from the beautiful blue flowered *Dolichos,* trailing round the cottage, and she is in debt to the contractor, who has advanced two rupees to be paid off in three months by the preparation of 240 ℔s. of catechu. The present was her second husband, an old man, by whom she never had any children, in which respect alone, did she think herself very unfortunate, for her poverty she did not feel. Rent to the rajah, to the police, and rates to the brahminic priest are here all paid from an acre of land yielding so wretched a crop of barley, that it more resembles a fallow field than a harvest. All day long the natives are boiling down the catechu wood cut into chips, and pouring the decoction into a large wooden trough, where it is inspissated.

This zillah is famous for the quantity of catechu its dry forests yield. The plant is a little thorny tree, erect, and bearing a rounded coma of well remembered prickly branches. Its wood is yellow, with a dark brick-red heart, most profitable in January and useless in June, (for yielding the extract.)

February 27th.—Left for Hirrah, (elev. 536 feet) through a similar country to that passed yesterday. Rocks all highly inclined, often vertical, of ribbon-jasper quartz and hornstone; monkeys, parroquets and hornbills, pigeons, owls and flocks of peacocks. Found a leguminous tree very like the *Butea* in every respect, but with small white flowers (probably *B. parviflora*) so abundant as to appear as if snowed upon. A *Gardenia?* with large yellow fruit eaten by the natives. *Phyllanthus emblica, Kydia calycina* and the dwarf *Phœnix.*

February 28th.—Marched to Kotah (elev. 542 feet), the path leading over hills with the bed of flinty rock projecting every where, to the utter ruin of our vehicles and the elephant's feet, and then over undulating hills of limestone; on the latter found a tree of *Cochlospermum,* its curious thick branches spread out something awkwardly, and each is tipped with a cluster of glorious golden yellow flowers, as large as the palm of the hand, and very beautiful. I think Lindley is certainly right in referring it to *Cisteæ;* it is a tropical *Gum-Cistus* in features, produce, color and texture of petals, and their caducous frail nature. It is a superb plant. The bark abounds in a transparent gum, which the white ants seem fond of, for they have killed many trees here.

At Kota, a small village at the junction of the Soane (elev. 543 feet), beside a river of that name, we encamped, and experienced another furious dust storm from the N. W.

Scorpions appear very common here, of a small kind, 1½ inch long. Several were captured and one stung one of our party on the finger; the smart was burning for an hour or two, and then ceased.

February 29th.—Being now nearly opposite the cliffs at Bidgegurh, where coal is reported to exist we again crossed the Soane, and for the last time. The ford is some three miles up the river, to which we marched through deep sand. On the banks saw a species of *Celtis* or *Sponia* covered with lac. This tree is said to produce it here in greatest abundance, as the *Butea* does at Burdwan and the Peepul in many parts of the country. I do not know which yields the best, nor whether the insects are different. The merchants do not distinguish the kinds. The bed of the river is about ¾ mile broad, and the rapid stream 50 or 60 yards, and breast-deep; the sand firm and silicious, with no mica;

nodules of coal are said to be washed down here from the coal bed of Burdee, a good deal higher up, but we saw none.

The cliffs come close to the river on the opposite side, their bases wooded and teeming with birds. The soil is richer and individual trees, especially of *Bombax, Pentapteris* and *Mahowa,* very fine; one tree of the *Hardwickia,* about 120 feet high, was as handsome a monarch of the forest as I ever saw, and it is not often that one sees trees in the tropics, which for a combination of beauty in outline, harmony of color, and arrangement of branches and foliage, would form so striking an addition to an English park.

There is a large break in the Kymaon hills here, through which our route lay to Bidgegurh and the Ganges at Mirzapore, the cliffs leaving the river and trending to the N. in a continuous escarpment flanked with low ranges of rounded hills and terminating in an abrupt spur (Mungeza Peak) whose summit was covered with a ragged forest. Kunch, the village at which we halted is elevated 556 feet above the sea; four alligators basked in the river, like logs of wood at a distance, all of the short-nosed or Mager kind, dreaded by man and beast; I saw none of the sharp-snouted or Gharial, so common on the Ganges, where their long bills, with a garniture of teeth and prominent eyes peeping out the water, remind one of geological lectures and visions of *Ichthyosauri.*

Botanized over the ridges near the river, but found little novelty. The *Mahowa, Ehretia, Hardwickia, Gmelina,* and especially *Diospyros* and *Terminalia* are the prevailing timber; the *Cochlospermum* on the very hottest and driest ridges, imitating the *Cistus* in habit; (and like the *C. Ladanum,*) it is streaming with gum as was the *Mahoowa* and *Olibanum. Catechu* and *Rhamneæ* are ever present and ever troublesome to the pedestrian. *Phœnix acaulis* frequent, and in some places the woods appeared on fire from the bushes of *Butea frondosa* in full flower.

March 1*st.*—Left the Soane and struck inland over a rough hilly country, covered with forest, good 1000 feet below the tops of the Kymaon table-land, which, as I stated above, here recedes from the river and surrounds an undulating plain, some ten miles either way, facing the south. With nothing but narrow paths much contrivance and labour were required to get the carts on. In one place I descended to the empty bed of a mountain torrent, which had cut a perpendicular valley through at least 30 feet of alluvium. Thence we plunged into a dense forest, chiefly of the above mentioned trees, with *Zizyphi* and several species of *Acacia;* a *Pterospermum* different from the more common or Parus Nath species, together with that plant, occur in the woods, with dwarf *Bauhinias,* but neither *Ferns, Lichens,* mosses, *Orchideæ,* or other tribes of a damp climate. Our course was directed towards *Mungeza Peak,* a remarkable projecting spur or nose of the Kymaon, between which and a conical hill the path led. Whether on the elephants or on foot, the thorny *Zizyphi, Acacias,* &c. were most troublesome, and all our previous *scratchings* were nothing to this. The low hills are round-backed masses of sandstone, with beds of shale interposed, but no coal. Peacocks and jungle fowl are very frequent, the squabling of the former and hooting of the monkeys constantly grating on the ear; other birds were very common. From the defile we emerged on to an open plain, halting at the village of Sulkun, elevated 671 feet.

In the afternoon examined the conical hill, which, like that near Rotas, is of stratified beds of limestone, capped with sandstone. A stream runs round its base, cutting through the alluvium to the subjacent rock, which is exposed and contains oblate spheres of limestone. These spheres are from the size of a fist to a child's head, or even much larger, are excessively hard and neither laminated nor formed of concentric layers. What they are I cannot tell, but have seen similar spheres from the Silurian rocks of Wales. At the top of the hill the sandstone cap was perpendicular on all sides, and its dry top covered with small trees, especially of *Cochlospermum.* A few larger trees were of *Fici,* which clung to the edge of the rocks, and by forcing their roots into the intestines detached enormous masses, affording good dens for bears and other wild animals. From the top the view of rock, river, forest and plain, was very fine, the edge ranging over a broad flat girt by the scarped hills of the Kymaon. The latter were continued along the Soane banks, further west, in a rugged range of hills.

From Sulkun the isolated table-topped hill of Bidjegur is seen, with its one large tree and the Palace at top, but the distance is considerable.

We were delayed three days at Sulkun, from inability to get the carts, &c. on, and my time being precious, I here took leave of Mr. Williams and his hospitable companions and started for Mirzapore. Mr.

Felle, a gentleman attached to the Revenue department, whom I had the pleasure of meeting at Sulkun, kindly escorting me to his residence at Shugunj, and forwarding both myself and collections with camels and elephants.

Both the climate and natural history of this flat on which Sulkun stands, are similar to those of the banks of the Soane; the crops are wretched, as are the people (Koles), an athletic-looking race however, often armed with spear and shield. At this season the dryness of the atmosphere is excessive.

Before leaving the Soane valley to ascend the Kymaon portion of the Vindhya hills I shall give an abstract of the Meteorological observations taken since leaving Tura.

VALLEY OF SOANE RIVER, TURA TO SULKUN, FEBY. 20TH—MARCH 3D.

	Temperature.				Wet Bulb.			Elasticity of Vapor.	Dew Point.					Vapor in cubic foot.	Saturation.			Number of observations.
	Mean.	Max.	Min.	Range.	Mean.	Max. Depression.	Min. Depression.		Mean.	Max.	Min.	Max. Depression.	Min. Depression.		Mean.	Max.	Min.	
Sun-rise ..	56.8	70.0	50.0	20.0	52.5	10.0	1.5	.380	48.3	53.1	41.1	17.3	5.4	4.240	.754	.831	.570	12
9 A. M. ..	82.0	89.0	69.0	20.0	61.2	24.3	12.0	.385	48.7	60.2	40.3	45.2	22.0	4.097	.342	.488	.226	11
3 P. M.….	88.6	94.7	81.5	13.2	62.4	30.2	14.5	.289	40.8	50.9	32.3	57.2	25.1	2.975	.211	.598	.154	11
9 P. M.….	68.0	74.0	61.0	13.0	56.8	15.0	6.0	.369	47.4	51.8	42.6	27.1	10.2	3.933	.511	.703	.415	11

Extreme variation of Temperature.………………= 44.7

,, ,, ,, Saturation………………= .677

,, diff. between Solar and Nocturnal Radiation…. 100

TURA TO SULKUN.

Nocturnal Radiation.

	Sun-rise.			Number of observations.	9 P. M.			Number of observations.
	Temperature.	Mean Diff. from Air.	Max. Diff. from Air.		Temperature.	Mean Diff. from Air.	Max. Diff. from Air.	
Exposed Th. ………	51.7	4.1	8.0	9	61.2	6.8	10.5	10
On Earth. ………..	52.4	3.4	7.0	9	64.3	4.6	8.5	9
On Grass. ………..	48.8	7.0	11.5	9	55.8	11.8	17.0	9

Tura to Sulkun.

Solar Radiation.

Morning.					Afternoon.				
Time.	Temp.	Black Bulb.	Diff.	Phot.	Time.	Temp.	Black Bulb.	Diff.	Phot.
11½ A. M.	85.5	129	44.5	..	3 P. M.	85.5	116	30.5	..
10½	89.0	132	43.0	..	..	92.5	128	35.5	..
Noon.......	90.0	132	42.0	10.140	..	92.0	120	28.0	..
„	85.0	130	45.0	..	..	89.5	128	38.5	..
„	86.0	138	52.0	..	..	93.5	144	50.5	..
„	90.0	138	48.0	..	..	..	..	..	..
Mean.......	87.5	133.2	45.7	10.140	..	90.6	127.2	36.6	..

Tura to Sulkun.

Nocturnal Radiation from Barley.

Sun-rise.							9 P. M.						
Temp. Air.	Barley.	Diff.	Calotropis.	Diff.	Argemone.	Diff.	Temp. Air.	Barley.	Diff.	Calotropis.	Diff.	Argemone.	Diff.
61.	56	5.0	56.5	4.5	57.0	4.0	68.5	..	..	..	..	56.0	12.5
57.	46	11.0	48.0	9.0	50.0	7.0	70.0	..	..	65.0	5.0	67.0	3 0
57.	52	5.0	..	..	50.0	7.0	69.0	..	..	57.0	12.0	57.0	12.0
58.5	52	6.5	..	..	..	..	74.	..	..	59.0	15.0	..	..
57.	52	5.0	..	..	..	..	62.5	51.5	11.0	..	..	..	..
50.	45	5.0	45.5	4.5	..	..	67.5	67.5	10.0	62.5	5.0	..	..
50.5	43	7.5	..	..	..	..	61.0	50.0	11.0	..	..	..	..
56.0	..	..	..	..	49.0	7.0							
55.8	49.8	6.0	50.0	6.0	51.5	6.2	68.	53.	10.7	60.9	9.2	60.0	9.1

The upper course of the Soane being in some places confined, and in others exposed to furious gusts from the gullies of the Kymaon hills, below Kotah, bounded by a continuous precipice of 1000 feet, and above it expanding into a broader and flatter valley, presents many fluctuations in temperature.

Exposed to the influence of radiation from so extended a surface, the mean temperature is much above that of the lower parts of the same valley (below Tura) the excess amounting to 5°.4. The nights and mornings are cooler, by 1.2 degrees, the days hotter by 10°. There is also 10° increase of range during the 13 days spent there; and the mean range from day to day is nearly as great as it was on the hills of upper Bengal.

There being much exposed rock and the valley swept by violent dust storms, the atmosphere is drier, the mean saturation point being here 454°, and in the lower part of the Soane's course 516°. On the other hand the variation in the amount of moisture suspended in the atmosphere is more variable than even on the hills above alluded to; the accumulation of moisture in the calm nights and closer parts of the valley being great; it is rapidly swept away by the periodic dry wind of the day.

A remarkable uniformity still prevails in the depression of thermometers exposed to nocturnal radiation, whether laid on the earth, grass, or exposed to the influence of the sky alone; both the mean and maximum indication coincide very nearly with those of the lower Soane valley and of the hills. The temperature of tufts of green barley laid on the ground is one degree higher than that of short grass as it grows; *Argemone* and *Calotropis* leaves maintain a still warmer temperature; from the previous experiments the *Agemone* appeared to be considerably the cooler, which I was inclined to attribute to the smoother and more shining surface of its leaf, but from these there would seem to be no sensible difference between the radiating powers of the two plants.

Here, as on the hills, there is less difference between the forenoon and afternoon indication of the black-bulb thermometer, than in the more open valley, which is to be accounted for by my having been obliged to choose too late an hour for the forenoon observation.

The rapid drying of the lower strata of the atmosphere during the day, as indicated by the great decrease in the tension of the vapor and the saturation point, from 9 A. M. to 3 P. M. is the effect of the great violence of the N. W. winds.

March 3rd.—Rode to Roump, at the top of the pass in the hills called "Ek powa" (or one foot) ghat. The village of Markounda, at the foot of the ghat, is situated by a stream running over flat beds of limestone, fissured as to resemble a tessellated pavement; the fissures were filled apparently with volcanic matter, but the evening was too fast closing in to allow of my examining it. This, the only ascent to the top of the hills for many miles around, is evidently the result of a fault, which has effected so broken an outline, that our path has been carried over the shattered crags. It is steep, rocky and covered with brushwood. On either side the precipices are sheer for many feet. At the summit we entered on a dead flat plain or, table-land with no hills, except along the brim of the broad valley we had left; where are some curious broad pyramids, formed of slabs of sandstone arranged in steppes.

March 4th.—Proceeded from Roump, which is about 400 feet above the plain, and 700 above the Soane, to Shahgunj, where I enjoyed Mr. Felle's hospitality for a few days.

The country here, though elevated is, from the nature of the soil and formation, much more fertile than what I had left. Water is abundant, both in tanks and wells, and rice fields, broad and productive, cover the grounds, tamarinds and mango topes now loaded with blossoms, occur at every village.

It is very singular that the elevation of this table-land (1103 feet at Shahgunj) should coincide with that of the granite range of upper Bengal, where crossed by the grand toll road, though they have no other feature but the presence of alluvium in common. Scarce a hillock varies the surface here, and the agricultural produce of the two is widely different. Here the flat ledges of sandstone retain the moisture, and give rise to none of those impetuous torrents which sweep it off the inclined beds of gneiss, or splintered quartz. Nor is there here any of the effloresced salts so forbidding to vegetation where they occur.

Wherever the alluvium is deep on these hills, neither *Catechu, Olibanum, Butea, Terminalia, Diospyros,* dwarf *Palm,* or any of this group of plants are to be met with, which abound wherever the rock is superficial, and irrespectively of its mineral or chemical characters, whether granite, gneiss, hornblende schists, hornstone, limestone or sandstone. On the other hand, the Banyan, Peepul, Mango, Tamarind, and even the Banana and Sugar-cane are found on the alluvium, though from the elevation and exposure these cannot attain the dimensions they do on the banks of the Ganges.

Acacia Arabica is abundant though not seen below, and very rare to the eastward of this meridian, for I saw but little of it in Birbhoom or Behar. It is a plant partial to a dry climate and rather prefers a good soil. In its distribution it in some degree follows the range of the camel, which is its constant companion over thousands of leagues. In the valley of the Ganges I am told that neither the animal nor plant flourish east of the Soane, where I experienced a marked change in the humidity of the atmosphere on my passage down the Ganges. It was a circumstance I was interested in, having first met the camel at Teneriffe and the Cape Verd Islands, the westermost limit of its distribution; imported thither, however, as it now is into Australia, where, though there is no *Acacia Arabica,* 400 other species of that genus are known.

Mr. Felle's bungalow (whose garden smiled with roses in this wilderness) is surrounded by a moat, fed by a spring; it was full of aquatic plants, *Nymphæa, Damsonium, Villarica cristata, Aponogeton,* three species of *Potamogeton,* two of *Naias, Chara* and *Zannichellia* (the two latter indifferently, and often together, used in the refinement of sugar). In a large tank hard by, wholly fed by rain water, I observed only the *Villarica Indica,* no *Aponogeton, Nymphæa* or *Damasonium,* nor did these occur in any of the other tanks I examined, which were otherwise well peopled with plants. This may not be owing to the quality of the water so much as to its varying quantity in the tank.

All around here, as at Roump, is a dead flat, except towards the crest of the ghauts, which overhang the valley of the Soane, and there the sandstone rock rises by steppes into low hills. During a ride to a natural tank amongst these rocky elevations, I passed from the alluvium to the sandstone steppes, and at once met with all the prevailing plants of the granite, gneiss, limestone and hornstone rocks previously examined, and which I have enumerated too often to require recapitulation, a convincing proof that the mechanical properties and not the chemical constitution of the rocks regulate the distribution of these plants.

Rujub-bund, (the name of the tank) is a small tarn, or more properly the expanded bed of a stream, for art has aided nature in its formation: it is edged by rocks and cliffs fringed with the usual trees of the neighbourhood; it is a wild and pretty spot, not unlike some birch-bordered pool in the mountains of Wales or Scotland, sequestered and picturesque.

Here again the *Aponogeton* and *Villarica cristata* grew, with several *Potamogetons, Chara, Zannichellia* and a floating *Utricularia.*

At 7 p. m. a tempest which had been gathering from the S. W. broke over Shahgunge, the lightning was very vivid, and the violence of the wind great. No rain fell, nor did the barometer indicate its approach. The day had been very close and sultry.

A columnar *Euphorbia, (E. ligulata?)* is commonly used here as a fencing, its pith is septate, a curious character, generally supposed to be peculiar to the pith of the Walnut tree. This is a matter of some interest, a fossil plant of the coal formation having been refered to the family of the Walnuts solely from its presenting this character.

One of the prettiest optical phenomena I have witnessed is frequent in the clear skies of these elevated regions: that of the false sunrise and sunset, often consisting of beams converging from the opposite horizon and meeting at the zenith the direct sun's rays. I have seen it equally vivid against a pure blue sky and against dark lowering clouds. The zodiacal light also shines with peculiar brightness, almost outshining the milkyway at times.

From the few days' observations taken on the Kymaon hills the temperature of their flat tops may be regarded as 5° higher than that of the valley, which is 500 feet below their mean level. I can account for this anomally only on the supposition that the thick bed of alluvium, freely exposed to the sun and not clothed with jungle, absorbs the sun's rays and parts with its heat slowly. This is indicated by the increase of temperature being due to the night and morning observations, which are 3°.1 and 8°.5 higher here than below, whilst the two of 9 a. m. and 3 p. m. are half a degree lower. What little alluvium there is on the Soane banks along its upper course is covered with jungle, thus excluding the solar rays, whilst the disproportionate amount of sterile rock rapidly parts with its heat and reduces the nocturnal temperatures. The vastly superior vegetation, both arboreous and herbaceous, of the Kymaon hills, is conclusive in favor of their superior soil and climate.

Table-land of Kymaon Hills, March, 3d-8th, 1848.

	Temperature.				Wet Bulb.			Elasticity of Vapor.	Dew Point.					Vapor in cubic foot.	Saturation.			Number of observations.
	Mean.	Max.	Min.	Range.	Mean.	Max. Depression.	Min. Depression.		Mean.	Max.	Min.	Max. Depression.	Min. Depression.		Mean.	Max.	Min.	
Sun-rise. ..	65.3	69.0	57.5	11.5	57.7	8.0	6.0	.428	52.0	55.5	45.9	14.1	11.6	4.710	.647	.741	.648	4
9 A. M....	81.6	83.5	79.5	4.0	65.3	19.0	14.0	.468	54.5	57.9	49.0	12.9	33.0	5.000	.421	.479	.344	3
3 P. M....	88.1	90.0	84.5	5.5	63.3	26.5	21.5	.324	43.7	47.8	37.9	46.6	42.2	3.417	.240	.295	.214	3
9 P. M....	71.1	76.0	68.0	8.0	60.3	13.0	8.3	.433	52.3	56.7	46.8	21.9	13.8	4.707	.542	.643	.491	4

Extreme variation of Temperature.................. = 32°.5

,, ,, ,, Saturation .... = .527

,, diff. between Nocturnal and Solar Radiation = 110.°5

Table-land of Kymaon.

Nocturnal Radiation.

	Sun-rise.				9 P. M.			
	Temperature.	Mean Diff. from Air.	Max. Diff. from Air.	Number of observations.	Temperature.	Mean Diff. from Air.	Max. Diff. from Air.	Number of observations.
Exposed Th.	59.5	3.5	3.5	2	71.5	3.3	7.0	3
On Earth, ..	56.0	1.5	1.5	1	62.5	5.5	5.5	1
On Grass, ..	54.7	8.2	8.5	2	61.0	8.2	11.0	2

The variations of temperature too are all much less in amount, as are those of the state of the atmosphere as to moisture, though the climate is rather damper.

On the subject of terrestrial radiation the paucity of the observation precludes my dwelling. Between 9 P. M. and sunrise the following morning I found the earth to have lost but 6°.5. of heat, whereas a mean of 9 observations at the same hours in the valley below indicates a loss of 12°.

There is as little similarity between the climate of the Kymaons and upper Bengal hills, as between their geology or outline, though so near in geographical position retaining the same mean level. The differences are analogous to them between the Kymaon and upper Soane valley, and are due to the very different surface soil and means of supporting vegetation.

Though the mean temperature deduced from the few days I spent on this part of the Kymaon is so much above that of the upper Soane valley, which it bounds, I do not suppose that the whole range partakes of this increase. When the alluvium does not cover the rock, as at Rotas and many other places, especially along the southern and eastern ridges of the ghauts, the nights are considerably cooler than on the banks of the Soane; and at Rotas itself, which rises almost perpendicularly from the river, and is exposed to no such radiation of heat from a heated soil as Shahgunge is, I found, the temperature considerably below that of Akbarpore on the Soane, which however is much sheltered by an amphitheatre of rocks.

March 7th.—Left Shahgunge for Mirzapore, following the road to Goorawal, over a dead alluvial flat without a feature to remark. Turning north from that village, the country undulates, exposing the rocky nucleus and presenting the usual concomitant vegetation. Occasionally park-like views occurred, which when diversified by the rocky valleys, resemble much the noble scenery of the forest of Dean on the borders of Wales. The *Mahoowa* especially representing the Oak, with its spreading and often gnarled branches many of the exposed slabs of sandstone are beautifully waved on the surface with the *ripple-mark* impression; of which impression a specimen was picked up at Rotas.

March 8th.—Having encamped at Amoee last night, I proceeded on to Mirzapore, descending a steep ghaut of the Bind hills by an excellent road, to the level plains of the Ganges.

During the few days spent at Mirzapore with my kind friend, C. Hamilton, Esq. I was surprised to find the temperature of the day cooler by nearly 4° than that of the hills above, or of the upper part of the Soane valley, the nights on the other hand were decidedly warmer. The dew point again was even lower in proportion, 7°.6 and the climate consequently drier. The following is an abstract of the observations taken at Mr. Hamilton's house on the banks of the Ganges.

Mirzapur Terrestrial Radiation at Sun-rise.

Air in Shade.	Exposed Th.	Diff.	Exposed on earth.	Diff.	Exposed on grass.	Diff.
60.0	55.0	5.0	..	..	52.0	8.0
62.5	54.5	8.0	56.0	6.5	52.5	10.0
63.0	55.5	7.5	50.5	12.5	50.5	12.5
58.0	53.0	5.0	54.	4.0	50.0	8.0
Mean, 60.8	54.5	6.3	53.5	7.6	51.2	9.6

Mirzapur, March 9th-13th, 1848.

	Temperature.				Wet Bulb.			Elasticity of Vapor.	Dew Point.					Vapor in cubic foot of atmosp.	Saturation.			Number of observations.
	Mean.	Max.	Min.	Range.	Mean.	Max. Diff.	Min. Diff.		Mean.	Max.	Min.	Max. Diff.	Min. Diff.		Mean.	Max.	Min.	
Sun-rise, ..	61.1	63	58	5	48.8	51.5	47.	.236	34.3	39.7	29.7	32.8	23.8	2.574	.405	.450	.327	3
9 A. M....	76.1	83	71	12	58.5	56.5	51.7	.302	41.9	..	..	52.3	15.7	3.271	.324	.603	.176	3
3 P. M.....	86.	..	..	..	61.7	24.3	..	.295	41.3	..	..	44.7	..	3.089	.264	..	..	1
9 P. M.....	76.	..	..	..	63.5	12.5	..	.480	55.2	..	..	20.8	..	5.127	.511	..	..	1

During my passage down the Ganges the rise of the dew point was very steady, the highest means being at the lowest point on the river, Bhaugulpore, which as compared with Mirzapore, showed an increase of 8° in temperature and of 30°.6. in the rise of the dew point. The saturation point at Mirzapore was .331, and at the corresponding hours at Bhaugulpore .742. (Saturation being represented as unity.) The observatious were taken at the house of my friend Dr. Grant.

It is remarkable that nocturnal radiation as registered at sunrise is much more powerful at Mirzapore than on the more exposed Kymaon plateaus; the depression of the thermometer freely exposed being 3° greater; that laid on bare earth 6°, and that on the grass 1°.4 greater on the banks of the Ganges.

A Resultant System for the Construction of Iron Tension Bridges.—By Major Henry Goodwyn, *Bengal Engineers.*

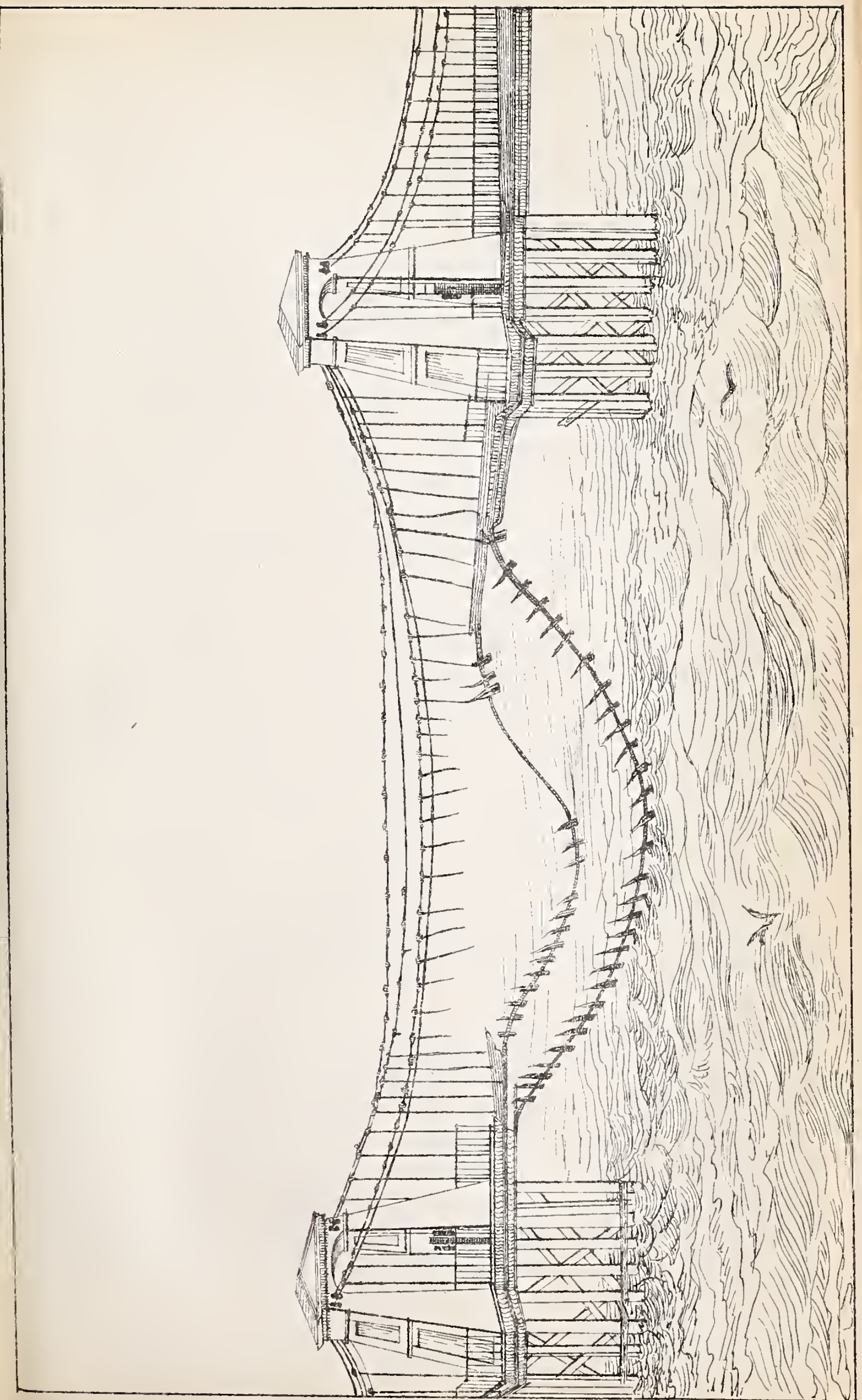
Description of the Frontispiece.

The view of the wreck of the Brighton Chain Pier as here exhibited, is a fac-simile copy of Pl. 90, of the "Theory, Practice, and Architecture of Bridges," published by Mr. Weale in 1843, in which the following brief, yet speaking account is given. The span of each curve is only 255 feet with a deflection of $\frac{1}{14}$th. The damage to the structure occurred in October 1833, when two curves and their platforms were destroyed. The second from the land side had twenty suspending rods carried completely away and many others seriously injured; the third division had 58 suspending rods destroyed. The chains were greatly deranged, and three-fourths of the platform and railing completely destroyed; the two divisions presenting an awful ruin. A rapid undulation was produced in the platform during the storm, and it sank nearly 6 feet on one side, presenting an inclined plane transversely.

It is remarkable, that notwithstanding the violent injury which the storm produced, the Longitudinal Iron bearing bar, with a Sectional area of only 4 square inches, was not broken, though it suffered severe torsion. A bar of the above Section supported the girders of the roadway to which the planks were fastened, and which bars were upheld by the stirrups at the lower ends of the suspending rods.

These remarks are made with reference to paragraphs 3, 4, 5, and 6 of the following Memoir, and the frontispiece itself introduced as an evidence of there being some great defect in the principle of construction which admits of a structure, which has been pronounced one of Sir Samuel Brown's best works, being thus seriously deranged by merely its own weight thus acted on.

The following practical conclusions are chiefly drawn from the demonstrated results of a "Memoir on the quantity of Iron necessary in a Tension Chain Bridge," by the Rev. J. H. Pratt, and published in the CLXXXVI. No. for January 1848, of the Journal of the Asiatic Society of Calcutta, and although a modified Taper Chain system had been drawn out and partially put into practice by me before the appearance of Mr. Pratt's theory, its principles agree so entirely with my



own experience, and its demonstration is so clear, that I have been induced from the wish to promote the advancement of such structures, to place the following exposition of my system on record, feeling sure that unbiassed minds will, on perusal, be divested of the timidity with which the extreme, or Dredge's Taper Chain system has been received, as its errors have been admitted and corrected; whilst, if there be any virtue in the present uniform chain system, the proposed "Resultant" will be found to possess them in an eminent degree, and yet freed from its acknowledged defects.

The fact demonstrated in the above named "Memoir" is simply this, that in all Iron Suspension Bridges of equal span, and breadth of platform, the quantity of Iron in the main parts must be *the same*, and that quantity which "is necessary to enable each part to sustain the greatest tension to which it may be subjected when the roadway is loaded to the greatest extent, is *altogether independent* of the principle of construction or form of the Bridge," provided of course that the principle be sound.

2. This is a very important conclusion, but whilst I freely admit the soundness of the doctrine, I am not fully satisfied as to the correctness of the writer's practical deductions therefrom, viz. that the old system of suspension, consisting of a uniform chain and vertical drop-bars, is the most proper for adoption under all circumstances. For such an opinion the author of the above "Memoir" gives his reasons, which, as might have been expected, are weighty enough, but "*good* reasons must per force give way to better," and notwithstanding what has been advanced above, I think the scale may yet be turned in favor of the opposite opinion, viz. that the old, or uniform chain system is by no means necessarily, and under all circumstances the most desireable for adoption.

3. If the strength or stability of a structure to resist a constant dead weight, were alone the points for consideration, the advantages adduced in favor of the uniform chain system might be conclusive; but wherever failures of Suspension Bridges have occurred, they have in almost every case been caused *not* by a steady, uniform dead strain, exceeding the power of the materials to resist, but by the effect of a much smaller load or weight in a state of motion. *Not*, for instance, during a trial by means of a *proof load* uniformly distributed, but by

the *motion* of a far smaller weight, as of a company of soldiers marching in step, as occurred to the "Broughton" Bridge, near Manchester, nay, the great "Manai" Bridge which was calculated to be equal to a load of 1245 tons in excess of its own weight, and the "Brighton" Chain Pier, (vide Frontispiece and description thereof), to an extra load of 100 tons, have both been nearly destroyed by merely their own weight when put in motion by a violent wind. The large suspension Bridge at "Montrose," which when first put up was proved by a dead weight of 970 tons, being the greatest it would have to bear, was destroyed in a similar manner.

4. The disastrous effects which have already occurred, and may still be apprehended from such causes, to bridges on the uniform chain system, are so universally admitted, that they need not here be further dwelt on; it will suffice to notice that no bridge of large span in any exposed locality, is ever put up without some special arrangement to counteract the vibratory and undulatory, tendencies of the structure. This protection is sometimes attempted by means of guy-chains, sometimes by a system of side and under trussing, (as in the Hammersmith Bridge,) at others by counter chains, (as in the Brighton Pier), the latter being intended to enable the platform to resist the lifting power of the wind from below.

5. From the result of the opinions on the disastrous effects of gales on the Menai Bridge in the years 1826, 1836, and 1839, and especially when during the latter, 148, or one-third nearly, of the suspending rods were torn asunder, no other conclusion can be drawn, than that the tubular rods introduced between the chains, the trussing of the roadway, the small brace chains, &c. did not preserve the bridge from the effects of the combined motions of the vibration, and undulation, of the chains,* which were the primary cause of the injuries sustained, and the reason is evident, viz. that these accessories contended against the effect, without attacking the *cause*. It will be therefore evident, that, something more than strength to resist a known strain in a certain direction, is required, and however true the main position demonstrated by the Rev. Mr. Pratt may be, it still remains an open question whether, in order effectually to meet the varied strains and trials to which Suspen-

* Vide Report by Mr. Provis, resident Engineer. Trans: Civil Engineers, Vol. 3. page 357.

sion Bridges are peculiarly liable, some other arrangement of the *same quantity of Metal,* as is now given to bridges on the uniform chain system, may not with advantage be employed.

6. Here it will not be irrelevant to observe that all the expedients had recourse to, for the purpose of counteracting the vibration and undulation of the uniform chain bridges, not only, of course, increase the expense, and weight of the structure, but absolutely negative the principal advantage expected from, and claimed for, that system, (viz. the simplicity and directness of the strains,) in the ratio of their attaining the object for which they were added, i. e. the stiffness of the whole.

7. Before proceeding to show, and I trust to prove, what will be a more advantageous disposition of a given weight of metal in a bridge of known size and proportions, than that which would be attained by the uniform chain principle, it will be necessary to notice a mode of construction for which a patent has been obtained by Mr. Dredge, who proposes to erect bridges of equal, or even greater strength, than those on the uniform principle, with about ⅓d of the quantity of iron usually employed in the latter; but as the practicability of such a result is wholly at variance with the demonstration proved by the calculations of the Rev. Mr. Pratt, now under reference, and as no one has yet impugned the correctness of the formulæ on which the strength of the uniform chain system is calculated, it is scarcely necessary to do more than base the rejection of Mr. Dredge's extreme taper chain system on the grounds of its non-conformity with the rules quoted above; unfortunately however, the Ballee Khâl Bridge near Calcutta, originally constructed in strict accordance with this principle, which fell by its own weight, and the inability of the "Kubudduk" Bridge near Jessore in Bengal, to withstand the ordinary proof trial, together with its subsequent failure, sufficiently confirm the accuracy of Mr. Pratt's conclusions. The iron work of the latter bridge was constructed by Mr. Dredge himself.

8. In the beginning of this "Paper" I remarked that I had practically, i. e. experimentally corroborated the fact demonstrated in Mr. Pratt's Memoir* and the failure of the Ballee Khâl Bridge led to so much study and research into the principles which should govern a

* Vide account of "Experiments" at the end of this Memoir.

Taper Chain Bridge, that the result has been an encouragement to combine the Taper Chain with the uniform system, possessing in conjunction the advantages of each, with the positive defects of neither, and which I will presently explain, after glancing at the evils which are acknowledged to exist in both the above principles.

9. The most important fact gleaned from the above experience and research is one entirely overlooked by Mr. Dredge, viz. that where *strength* or *section of Iron* is taken away from the chains, it should be made good in the *Longitudinal Beams* to which they are connected. Not that the precise quantity abstracted from the former should be added to the latter, but that additional strength should be given to the beams bearing a certain ratio to that taken from the chain. Mr. Dredge, and the uniform chain system, afford instances of opposite extreme cases. In the former, the section of the outer longitudinal beams at the centre, where the chains are a minimum, should be nearly equal to the entire section of the chains at the point of suspension, the portion of beam in the centre of the bridge standing in place of the chain theoretically, and almost so *in practice;* in fact the longitudinal beam is an indispensable item in the Dredgeian combination, whereas in the uniform system the reverse is the case, for by the non-diminution of the chain in the centre, there is no absolute necessity for the longitudinal beam as a component portion of construction.

10. The principal defects of Mr. Dredge's extreme Taper system are,

1st. The hazard of trusting a bridge, whatever the span may be, to the strength of *one*, or even *two* rods at the centre, for (admitting for the sake of argument, that the section there may not be disproportioned to the strain) yet the fracture of the link in the centre, (and being so slender there is the greater probability of such an event there than elsewhere) would be attended with very dangerous results; the conclusion therefore to be drawn from the admitted inexpediency of confiding in the strength of so small a section of iron in the very centre of the bridge is, that the chain should not diminish so rapidly as, in the extreme Taper system, it does.

11. 2ndly. As noticed above, the section of iron in the longitudinal beams is uniformly weak throughout with reference to the tension at the centre, which, where the beam comes in place of the chain, is infinitely great, as compared with that exerted near the standards.

12. Here, as regards the second defect, it may be objected, that Mr. Dredge never intended his bridges to be sustained by tension in the longitudinal beams at any point of their length, assuming in his theory that "the tension at the centre is a cypher." The capacity of the platform to resist *compression* in the two half curves, and not the power against *tension*, being brought into action.

13. Such has been Mr. Dredge's view and his rule of construction, but experience on a full sized scale, (independent of the failure of the bridges above noticed) has satisfied me that there is not strength in the combination of the platform to resist compressive power. The defect was proved as follows :—

14. The whole of the iron work of a complete half curve of a bridge of 120 feet span and 16 feet width of platform, was put up in the Government Iron bridge yard on standards erected of masonry for the purpose, thus : (See Fig. 1.)

The centre link was carried out horizontally in its proper position, and attached to a wooden beam abutting against two trees. The central ends of the longitudinal beams were left free, as shown above, the other ends being built firmly into the masonry in their cast iron boxes, whilst the half platform rested on three posts on each side, to preserve the horizontality till the whole was put up. Every thing being in position, the transverse beams, railing, &c. fixed, it is evident that on the removal of the posts the structure would not fail, if there was sufficient stiffness in the combination of the framing, to resist the compressive action by the combined oblique pull of the auxiliary rods depending from the chain; accordingly the posts were one by one removed, when it was immediately seen that there was not that degree of stiffness in the framing to resist the amount of compression from the centre towards the standards, for when all the posts were removed, about one-third of the length of the platform from the standards was bowed out 25 inches, as in the annexed figure. (See Fig. 2.)

There was at this time no extra load on the platform, and the conclusion seems obvious, that unless the longitudinal beams be kept straight by tension from the opposite half curve, the framing could hardly bear its own weight, far less be equal to a traffic load of 112℔s. per square foot. In other words, the combination and scantling assigned by Mr. Dredge have not strength to resist the compression; the stability therefore of the structure must depend on the capability of the longitudinal beams to resist tension.

Mr. Dredge has in fact carried the principle too far, and has concluded that, because the lowest point of a chain is that of least tension, such an arrangement may be effected by which there shall be none at all. He has also assumed perfect rigidity for his platform, which is composed of a flexible combination, and which, if in the slightest degree displaced, causes collapsion of the whole.

15. The third defect in the extreme Taper chain system is the great obliquity of the central auxiliaries, and the great difference in the angles of obliquity; varying from 10° at the centre to about 65° at the standards; the strains to which they are exposed by equal weights are consequently very unequal. This conclusion hardly requires elucidation, but the subjoined diagram (Fig. 3.) drawn to a scale, and on the principle that, when three forces are in equilibrio the strains in each direction are proportional to the sides of a triangle in the direction of the forces, shows the actual tension on the central oblique rod, and in that nearest the standard, of a bridge constructed strictly on Mr. Dredge's system, the angles of attachment being 59° 19′ at the standards, and 9° 30′ at the centre. (See Fig. 3) or as in Fig. 4, the weight being in both cases expressed by unity. (See Fig. 4).

The tension on the first oblique rod from the pier will be 1.18 and the horizontal tension 0.6, whilst that on the central oblique rod will be 6.14, and on the horizontal line 6.05, so that equal sections of iron are strained in the proportion of 6 to 1.

16. The advantages of the above system are, first, that a considerable portion of the platform is supported by rods direct from the standards, thus leaving a diminished tension due to the chain, and secondly, by the oblique action of the auxiliary rods the system is retained under the dominion of a certain amount of Tension, rendering the roadway free from the injurious effects of undulation and vibration, and making the transit more firm and pleasant.

17. The defects of the Uniform chain system are,

1st. The whole weight of the bridge is supported by the chains, rendering them very heavy, massive and costly, as also more susceptible of receiving the impulse, which in storms is the primary cause of the destructive motion given to the roadway.

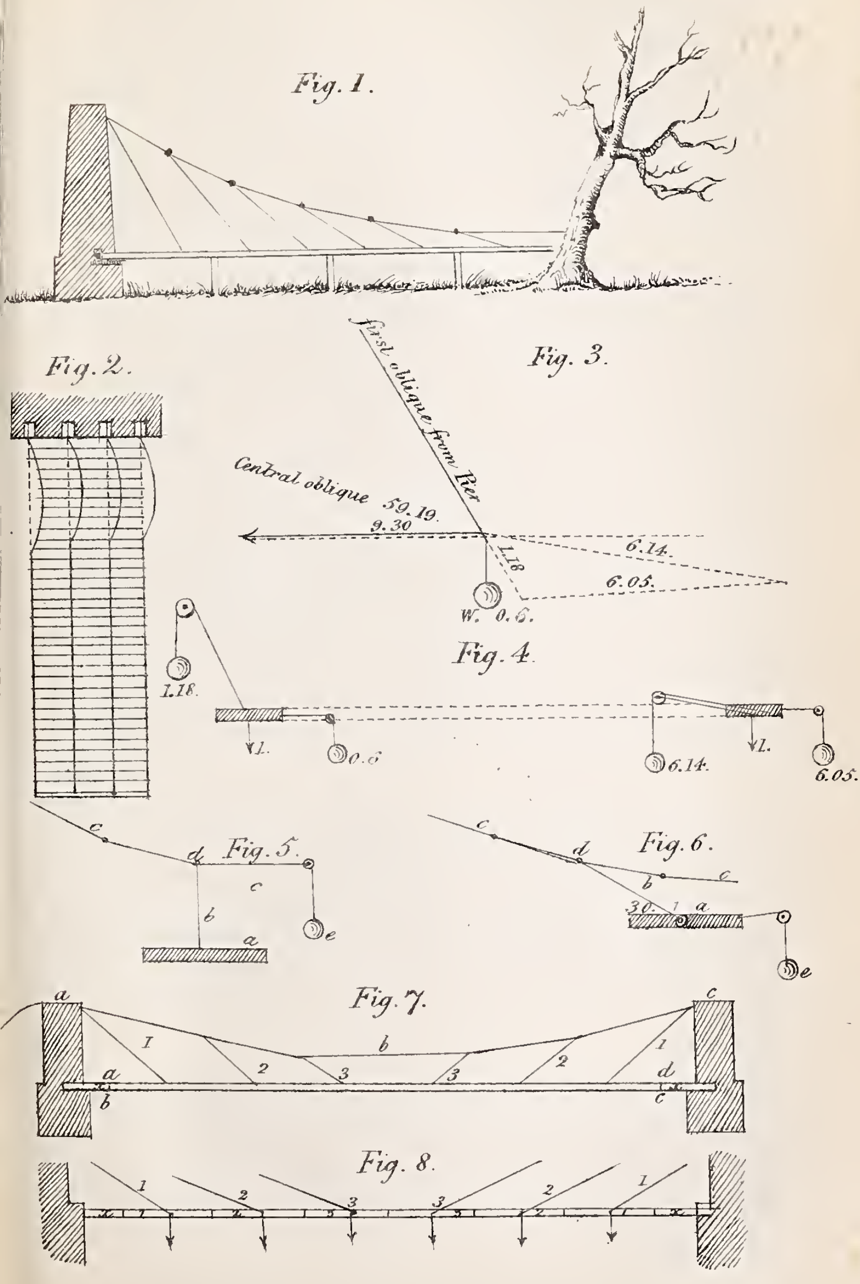


Fig. 1.
Fig. 2.
Fig. 3.
first oblique from Pier
Central oblique
59.19.
9.30
1.18
6.14.
6.05.
W. 0.6.
Fig. 4.
1.18.
1.
0.6
6.14.
1.
6.05.
Fig. 5.
c
d
c
b
a
e
Fig. 6.
c
d
c
b
30.
1
a
e
Fig. 7.
a
I
b
2
3
3
2
1
c
a
b
d
c
Fig. 8.
1
2
3
3
2
1

18. 2ndly. The platform being wholly supported by the action of gravity, the equilibrium of the system is disturbed by the most trivial causes, the transit even of a single foot passenger over a bridge of 200 feet span produces a sensible vibration, whilst the motion of heavy bodies is attended by effects actually injurious to the structure, and it may therefore be readily conceded, that the effects of storms is very much to be dreaded, of whieh the Menai, the Brighton Pier and Montrose bridges are instanees.

19. Few, if any suspension bridges on the uniform system are constructed on any very close calculations of the strength of the different parts ; generally a very wide margin is allowed over and above the power required by calculation; thus the Menai bridge is equal to a permanent load of nearly 400 tons above the weight of suspended roadway, added to a full load of 75 ℔s. per square foot ; and the bridge at Montrose is equal to nearly 100 tons in excess of the entire load to whieh it can be subjected, yet notwithstanding this excess of strength in actual section of iron in the chains, these bridges have been in imminent danger of total destruction when *unloaded*, from what may safely be called the defects of construction; surely nothing need be added to show the inexpediency of providing a vast excess of strength in any structure to meet a dead weight which it ean never be subjected to, and at the same time leave it unprotected to encounter the danger of disruption to which at any hour it may be exposed from natural causes?

The lately constructed bridge at Hungerford Market over the Thames, 676 feet span, has a sectional area of 312 square inches, and as the actual tension on the chains, even with the enormous assumed weight of 170 ℔s. per square foot of platform, could not exceed 1420 tons which @ 9 tons per square inch, requires 156 square inehes, there is exactly double the section or strength necessary for the strueture.

Resultant System.

20. I will now proceed to explain a system whieh only proposes to do what the formulæ in Mr. Pratt's Memoir says may be done, which is based on the experience and research I have above noticed, and which proves what it engages to do, in a manner, I trust, unexceptionable. For,

already have the Ballee Khâl bridge, the Kubudduk bridge, and five other bridges of spans varying from 200 feet to 120, which were originally constructed on the extreme Taper chain principle, been (as far as was practicable) remodelled on the system I am about to advert to, and most of which have now been erected 3 years, fully proved by previous loading, and subjected to very heavy traffic and storms. It is merely a different application of the uniform chain system, though it partakes of both that and the Taper chain; I term it "The Resultant," indicating thereby that the chains by construction, are in absolute strength, and in the direction of their links, "Resultants" of the tensions due to the adjoining link and auxiliary depending therefrom. It is in fact emphatically a system of equilibrium. The chief differences between it and the old system consist in a modified reduction of the section of iron in the chains from standard to centre, with a corresponding increase in the horizontal power in the opposite direction; in fact, transfering in part the horizontal tension, which, together with the oblique, is borne by the chain in the uniform system, to the line of the platform by means of the deviation of the suspending rods from the perpendicular.

21. In the uniform chain system, as is well known, the suspending rods are vertical. In the "Resultant," they are set at an angle with the roadway, and in proportion to the deviation of this angle from the vertical line, a new element is brought into operation, viz. tension in the horizontal line. This does not affect the principle of construction, but only renders necessary a new distribution of the forces required to support the structure; this will be evident from the consideration of annexed diagram (Fig. 5.) which represents the principle of the uniform chain, in which the oblique and horizontal tensions are borne by the chain alone, and as these are nearly equal, the power or section of the chain in either direction from point D must be equal also. (See Fig. 5).

Here the weight of the portion of platform A to be supported is sustained by a single force B, from the main chain C. C. If therefore A=8 tons, the rod B must be equal to that strain. Fig. 6, is an example of the "Resultant" principle, in which the portion (See Fig. 6) of platform weighing, as before, 8 tons, is supported by two forces, viz. the oblique rod B, in the direction b D. and the horizontal force E. Supposing the angle at b to be 30° the rod B. will be strained with a power of (the weight × by cosecant of the angle b)=16 tons, whilst the horizontal force or (weight × cotangent of the angle b)=14 tons.

Now although in the first instance the actual tension on the rod B is only 8 tons, and by that the weight is upheld, whilst in the second the total amount of sustaining power is 16+14=30 tons, yet mark the difference of effect on the chains from which such rods are suspended. In a bridge of 160 feet span and 20 feet width of platform (for example) the area to be supported will be 3200 square feet, which, at 120lbs. per square foot will be 172 tons. With an angle of suspension of 15° the tension on the chain in the uniform system will be $\frac{1}{2}$ weight × by cosecant of the angle of suspension, or $\frac{172}{2} \times 3.86 = 332$ tons.

In the "Resultant" system (vide Fig. 17, in which the entire series of strains have been worked out as shown in the table) the extreme tension on the chain, or that due to the upper link, is 192.82 tons, the difference being made up in the tension on the horizontal beam, for which a proportionate section of iron is allowed, and this horizontal beam is not an extra item introduced merely to meet the strain, but is a component part of the system of framing of the platform, and as necessary to the whole as the platform of any ordinary suspension bridge.

Here then it is apparent that, in Fig. 5, the weight supported vertically causes a tension of 332 tons on the upper link of the example above mentioned, and that a proportional section of iron must be given to meet that strain, and not only that, but the same section must be continued throughout the whole series of links; whereas, as in Fig. 6, the extreme tension on the chain, with an equal load, is only 192.82 tons, so that its section can be reduced in the proportion of 1 to 1.72 in the upper link, each link in the descending curve becoming lighter in proportion to the extent of diminution allowed; in addition to which advantages the chain links, by the oblique position given to the suspending rods, are strained in the direction of their length, the most favorable to which they can be exposed. Finally if the weight of the whole series of chains, links, and vertical rods in the old system, be compared with the chains, oblique rods, and longitudinal beams of the "Resultant" system, for any given bridge, it would be seen that the two correspond as nearly as can be obtained in practice. This I have proved beyond doubt from the result of those bridges enumerated in the 20th paragraph, as remodelled on the "Resultant" system.

22. I will now detail the theory on which the "Resultant" principle is based.

In Fig. 7, A B C represents the chain of a tension bridge, the centre link of which is above the level of the railing; a b c d, the roadway, or suspended platform, (See Fig. 7,) the small portions x x being supported by the abutments. Let 1, 2, 3; 3, 2, 1, be the auxiliary oblique rods from the chain, the angle of those at the centre not being less than 25° and those next the standards not greater than 45°. It is evident that the platform is entirely upheld by the auxiliaries, and it is to them therefore that our attention is first directed.

23. The auxiliary rods being by construction attached at equal distances, it is intended that each set shall bear an equal duty or tension, and as the stiffness of the platform to resist the force of gravity is uniform throughout, the whole series of oblique rods benefit equally thereby, and being thus common to all, it may be omitted in considering the strains on the auxiliary rods. (See Fig. 8).

Suppose the platform to be divided into as many equal parts as there are oblique rods, thus giving to each rod an equal load, the points of attachment of which being the centres of gravity, we have six rods, 1, 2, 3, 3, 2, 1, supporting the equal portions of platform having corresponding numbers.

24. The several portions of the platform acting by gravity whilst the sustaining force is oblique, a third force is necessary to preserve the whole in equilibrio. This force is, in the present system, tension in the horizontal line as shown in annexed Fig. 9, and acting from the standard towards the centre. These three forces, viz. vertical, oblique, and horizontal, being in proportion to the radius, cosecant, and cotangent of the angle of obliquity; the tensile force being that under consideration, it is necessary to connect the portions of the platform in Fig. 8, in such a manner that the weight or force of gravity shall act freely, whilst the several parts are prevented from separating. Fig. 10, will show the meaning.

Here we have the tensions on the several portions 1, 2, 3, on one side, or half span, counterbalanced by an equal amount of tension on the portions 3, 2, 1, of the opposite half, hence the greatest strain is in the centre, which has the pull of 3+2 + 1 acting on it; the connecting link between 2 and 3, being strained with the tension of 2+1, and that between the parts 1 and 2, with the strain due to the part 1 only. Now the outer longitudinal beams of the system stand in the place of the connecting links of the above Fig. 10, and are exposed to the varying tensile forces as described along the whole length, the amount of each of which admits of easy calculation, and whilst the precise spot of the greatest effect can be exhibited, the exact amount in every portion of the system can be accurately ascertained, and consequently provided for.

25. The following Figs. 11 and 12, will show the relative tensions in the oblique and horizontal directions, in both Mr. Dredge's and the present "Resultant" systems. Fig. 11, showing the strains where the oblique rod angles vary, as practised by Mr. Dredge from 10° to 60°, and Fig. 12, the strains where the variation of the angles is only from 25° to 45°. (See Figs. 11 and 12).

The force of gravity being represented by unity in both cases the extreme difference in the amount of tension in the oblique rods of Mr. Dredge's combination is as 5 to 1, and in the horizontal beam as 10 to 1, (Fig. 11.) whilst in the "Resultant" system under adoption, as shown in (Fig. 12.) the variation of tensions in either direction between the centre and standard is as 1.4 to 2.2 greatly to the advantage of the latter.

26. Now to apply the same principle of the composition of forces to the chain, so that the system may be in equilibrio. The span, width of roadway, its construction, the spaces between the oblique rods, and angle of the central one being determined, the weight to be assigned to each set of auxiliaries may be safely assumed at 120 lbs. per square foot of platform, including the weight of the structure.

27. The tension on the centre, or horizontal link may be arbitrarily assumed, i. e., it may be made any proportion of the link at the point of suspension, thus tapering the chain $\frac{1}{3}$d, $\frac{1}{4}$th or $\frac{1}{n}$th, part of the sectional area of the upper link, for it is evident that by the arrangement of the angles formed by the first link from the centre and first set of oblique rods, the strain on the centre link may be =0, or =1000 tons, as is shown in annexed Figs. 13 and 14, where it is clear (Fig. 13.) that the tension on the centre link c. b. is increased or diminished as the line c. e. (the prolongation of a. c.) approaches nearer to c. b. or c. d.;

the tension on c. b. will be a maximum when a. c. b. are in one line, and a minimum (Fig. 14.) when a. c. d. are in one line. The minimum of the central angle has however been practically determined to be 25°, with a view to the equilization, as far as practicable, of the strains on the entire series of oblique rods.

28. We have thus the means of assigning to the centre link any amount of power; its direction, (horizontal) is known as well as the tension and direction of the central oblique rods, we have therefore two forces, the magnitude and direction of which, with reference to each other, are known, from which to obtain a resultant, which shall be the first link from the centre. And here it must be borne in mind, that the height of the point of suspension and consequently deflection of the chain depend on the power of the centre link, for the resultant, or first link from the centre will form a greater or less angle with the horizon as its direction approaches less or more to that of the centre link, and the resultants arising therefrom, as the series of the chain draws nearer to the standards, will all be similarly affected.

29. The first resultant from the centre link and oblique rod is obtained from the following expression, (Fig. 15.)

Suppose given A B=200 centre link.
A C= 33 centre oblique rod.
∠ A C E or C A B= 25° ....
} The actual forces in the bridge designed for the "Jumna" at Agra.

to find the magnitude and direction of A. D.

By Trigonometry,

$$A\,D^2 = A\,C^2 + A\,B^2 - 2\,A\,C.\,A\,B.\ \text{Cos}: A\,B\,D$$
$$= A\,C^2 + A\,B^2 + 2\,(A\,C.\,A\,B\ \text{Cos}: A\,B)$$
$$= 1089 + 40000 + (13200 + 906)$$
$$A\,D = \sqrt{53048} = 230.32 = \text{magnitude of } A\,D.$$

Again,

$$A\,D : \text{sin. } B\,A\,C :: \left\{\begin{matrix} C\,D \\ A\,B \end{matrix}\right\} : \text{sin. } C\,A\,D.$$

Sin. B A C=25°	.... log.	9· 625948
A B=200	....	2· 301030
		11· 926978
A D=230·32	....	2· 362332
Angle C A D=21°.32′	....	9· 564646

Fig. 9.

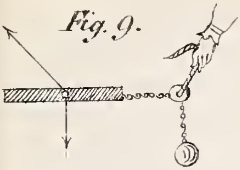


Fig. 10.

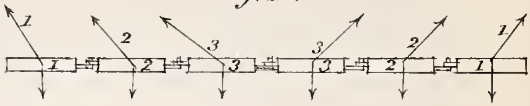


Fig. 11.

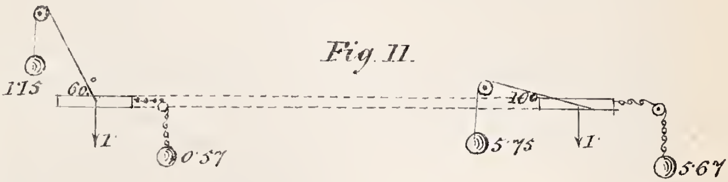


Fig. 12.

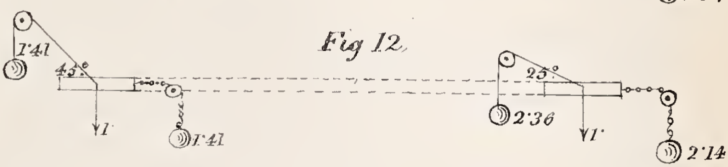


Fig. 13.

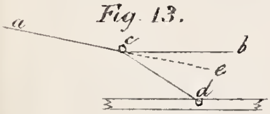


Fig. 14.

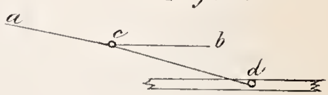


Fig. 15.

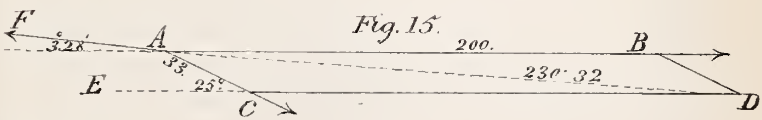


Fig. 16.

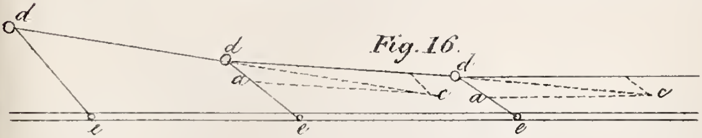


Fig. 19.

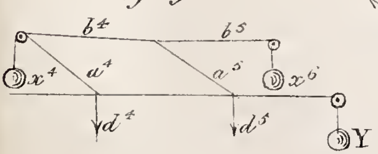
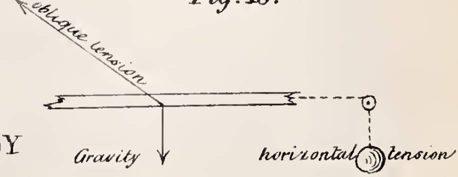


Fig. 18.



And angle C A B—angle C A D$=25^{\circ}-21^{\circ}\cdot 32'=3^{\circ}.28$, or angle of first resultant A F with the horizon. Thus the magnitude and direction of the first link are found, and the link is a true resultant of the two forces acting at its lower extremity. In like manner can each link be ascertained till the series is complete, and thus a perfect system of links and auxiliaries will be obtained in equilibrio, under the maximum strain to which the structure can be exposed.

30. By reference to annexed Fig. 16, the formation of the chain will be readily understood from the mechanical construction, as, shown in the dotted lines, which are the forces taken from a scale of equal parts, and correspond with the results obtained by the mode of calculation above referred to. (See Fig. 16.)

The points of attachment, e, e, e, of the oblique rods and platform, are originally known, the span being divided into a number of equal parts; the length of the links or points d. d. d. are found by the annexed formulæ (Drewry, p. 172).

$\sqrt{(\text{deflection} + \frac{\text{deflection}}{3})^2 + \text{semichord}^2} =$ semilength of chain, which must be computed independent of the centre link. The semi-length thus obtained is to be divided into as many links as are required, which will of course depend on the number of spaces of the platform upheld direct from the standards (Fig. 17). The deflection may be assumed any proportion of the chord line from a 10th to a 15th. In small bridges the latter is the best as affording greater rigidity, with but little extra material; in large spans, perhaps a medium, or $\frac{1}{12}$th will be found most practicable. In the above Fig. 16, a c, a c, represent the strains on the main chains, a d, a d, the tensions on the oblique rods, and c d, c d, the resultants.

31. In a bridge on the resultant system of 500 feet span and 24 feet width of roadway, if the chain were made to taper at the centre to $\frac{1}{5}$th the section of the link at the point of suspension, which in this case would be equivalent to the tension of 1014 tons, the central link would have 9 times the strength, that in the extreme, or Dredge's tapering system, would have been assigned to it, whilst from the position of the resultant link, and collateral oblique rods, the iron in the centre, does not hang as dead weight tending to produce vibration by the slightest cause, as in the uniform system, but is kept under the dominion of tension drawn in the direction of its length, and thus preserved steady and rigid.

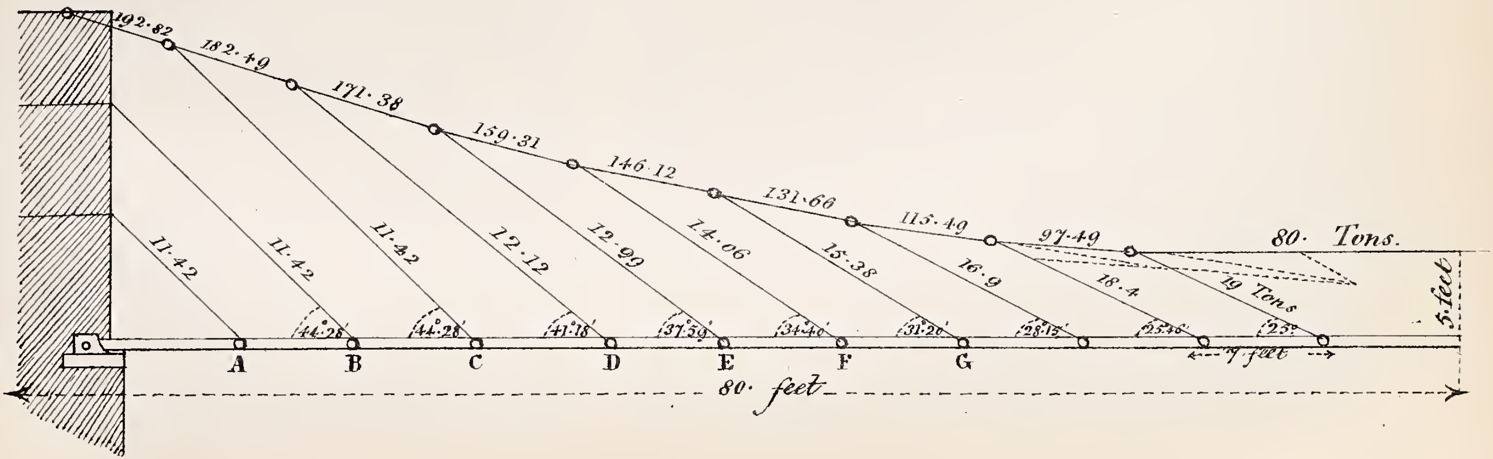
32. In paragraphs 24, 25, the principle that is to guide the construction of the longitudinal beams has been given, viz. as the third force acting by tension horizontally to preserve the equilibrium with the oblique force and that of gravity; and in paragraph 9, full explanation of the reason of the above arrangement has been entered into, aud it has also been shown that provision can be made to meet the several amounts of tension acting on the beam in the horizontal line. If this were all that the longitudinal beam had to perform, a construction similar to Fig. 10, would answer the purpose, and the section of the different portions might diminish from the centre, towards the standards in proportion to the variation of the strains produced by the auxiliaries, but as these beams are intended to bear the vertical weight of the platform together with the heavy traffic load, and other contingencies, a compact or uniform section should be retained in bridges of small span equal to that demanded at the centre, which will be the most advantageous to the system, and facilitate the actual construction, though in larger spans a considerable reduction of section may be effected between the centre and standards.

33. The "Resultant" system as above elucidated, cannot surely fail to present many valuable points for recommendation, professing, as it does, practically to coincide with the theoretical and analytical conclusions of the author of the "Memoir" under notice, aud moreover, whilst it is divested of the positive defects of both the systems which have been simultaneously reviewed, a powerful resultant is obtained from the composition of the advantages or forces of each of them. This system has been somewhat hastily "damned with faiut praise," by some, because they would not take the trouble to ascertain its principles of construction; it has been passed over by others, from absolute inability to understand them, simple as they are, but from what has been shown above it will be clear that, with the condemnation of the "Resultant" system, the uniform must be included, the latter being nothing more than an extreme case of the general system in which the strain on the chain is a maximum, and the horizontal tension is 0, whilst the system of Mr. Dredge in a way aims at, (but does not attain,) the opposite extreme, where the tension on the chain is a minimum, and that on the horizontal line a maximum.

34. It now remains to show another advantage of the "Resultant" system with a diminishing chain. The annexed Fig. 17, is the con-

Pl. XXVI.

Fig. 17.



structed resultant curve of a bridge of 160 feet span as designed, with the several forces and angles delineated, and the subjoined table shows the forces from which each link has been obtained, their magnitude and direction; it will be obvious that the horizontal tension of each portion of platform supported by an oblique rod will be communicated through the medium of the side longitudinal beams from the standard to the centre, so that the tension on one half the bridge is counteracted by that on the opposite half; this amount of tension in a loaded bridge of large span is very great, (600 tons in a span of 500 feet, and 24 feet wide) being the sum of all the horizontal tensions A+B+C+D+E, &c., and as the ends of these side beams are securely built into the standard masonry, the swaying of the structure from side to side, or undulation vertically under the influences of storms, or other ordinary destructive causes, (excepting to a very slight extent) is prevented. At the proof trial of the Ballee Khâl bridge, 250 feet span, after its reconstruction on the Resultant principle, the transit of a large elephant, and 24 pounder siege gun (See Fig. 17. also Table next page) with all its appurtenances, caused no sensible vibration, or visible depression, whilst at the conclusion of the ceremony the entire platform was covered with a dense crowd of villagers, who, on the departure of the Governor and suite came to witness the opening, and congregated as far as they were able to one side of the bridge, thus giving fair proof of the stability and rigidity of the structure.

35. If therefore, as demonstrated by the Rev. Mr. Pratt, the quantity of iron calculated to resist a certain dead weight, be the same for bridges of equal span and width, and of equal strength, whether the metal be distributed, as in the uniform system, or as in the "Resultant," it surely is no small advantage in favour of the latter, that, by construction, it is defended from the severe trials to which all bridges, even when unloaded, are exposed, from the momentum which a comparatively light body obtains when put in motion.

36. The extra aid usually applied to suspension bridges on the uniform system for the purpose of stiffening them, has been found absolutely necessary, and duly commented on in paragraphs four and five, and whilst such means are almost indispensable in the old system, to compensate for vicious construction; in the resultant system they form an essential part of the principle; and considering the results of the experiments on a full-sized scale, (vide end of this memoir) the

favourable reports on those bridges actually constructed on the resultant principle, together with the theoretical soundness of the details, it appears neither reasonable or consistent to object to it since it has every good quality that such a structure can require, to recommend it.

Table Showing the Forces of Links and oblique Rods, with the Resultants obtained therefrom.

See Fig. 17.

Forces composing the Resultants or Link of chain.	*Forces due to chain.*	*Angles of oblique rods with horizon.*	*Cosecants of angles of oblique rods.*	*Angles of oblique rods with chain.*	*Weight of one space of platform.*	*Angles of chain links with horizon.*	*Cal. Resultants or Tension on chain links.*	*Position of Link.*
	Tons.							
Centre link,	80	....	....	....	....	....	....	Centre link.
Centre oblique rods, ..	19	25°.	2·366	25°	8 Tons.	5°.45′	97·49	1st link from centre.
1st link from centre, ..	97.49							
2nd set of oblique rods,	18.4	25°.46′	2·3	20°.1′	,,	8°.58′	115·19	2nd link from centre.
2nd link from centre, ..	115.19							
3rd set of oblique rods,	16.9	28°.15′	2·113	19°.17′	,,	11°.24′	131·66	3rd link—ditto.
3rd link from centre, ..	131.66							
4th set of oblique rods,	15.38	31°.20′	1·923	19°.56′	,,	13°.27′	146·12	4th link—ditto.
4th link from centre, ..	146.12							
5th set of oblique rods,	14.06	34°.46′	1·758	21°.13′	,,	15°.17′	159.31	5th link—ditto.
5th link from centre, ..	159.31							
6th set of oblique rods,	12.99	37°.59′	1·624	22°.42′	,,	16°.57′	171·38	6th link—ditto.
6th link from centre, ..	171.38							
7th set of oblique rods,	12.12	41°.18′	1·515	21°.21′	,,	18°.31′	182·49	7th link—ditto.
7th link from centre, ..	182.49							
8th set of oblique rods,	11.42	44°.28′	1·427	25°.57′	,,	20°.	192·82	8th link—ditto, or upper link of chain.

Results of a series of experiments instituted for the purpose of testing the newly proposed Resultant Taper Chain principles.

Pl. XXIV. Fig. 1, is illustrative of the first experiment, which was intended to test the theory of a system based on the "resolution of forces," as explanatory of the proposed construction of the Agra bridge.

The idea of compression in the horizontal line having, from actual proof, been deemed untenable in bridges of any ordinary span, the opposite power of tension has been admitted as the third in the series to produce an equilibrium jointly with those of gravity, and the tension in the oblique direction from chain to platform, thus: (See Fig. 18). The oblique and horizontal force in a series bearing theoretically a certain proportion to each other with reference to the obliquity of the former, the weights at each point being uniform; this experiment was instituted to prove practically how far that theory was correct.

It was also intended to illustrate practically the theory relative to the position and power of the chains, the links of which are calculated to be true resultants from the two forces immediately below them in the chain, viz. the link and oblique rod attached to the lower extremity of that resultant.

Fig. 1, shows the experiment which was to prove whether, individually or collectively, the several sets (three forces applied to any point to produce equilibrium) of forces which may be applied to any single rod, link, or the entire series of rods and links, will be proportionate to the different strains, which are those calculated as due to the parts of a bridge of 100 feet span, 16 feet wide, constructed on the above principle.

The experiment was on full scale as regards heights and distances, but formed of material $\frac{1}{220}$th of the strength of the real bridge, the uniform weights at the points of junction of the oblique rods with the platform being in the same proportion, allowing 120 lbs. per square foot.

The point of suspension is 2 feet from the centre of the standard, making the half span of the chain 48 feet.

The power of the centre link, by actual construction, was made equal to $\frac{1}{4}$th that of the upper link, or whole amount of tension which would be due to a uniform chain, and the angle of the central oblique rod determined to be 30°., the deflection being $\frac{1}{11}$th.

The chain was not at first attached, but the forces necessary to preserve equilibrium at the points of attachment of the oblique rods with the platform, first attended to, as follows, each of the portions of platform (c, c^1, c^2, &c.) being separate at first, and afterwards flexibly connected.

To the portion (c) with a weight (d) of 56 ℔s. was attached a single rod (a) passing over a pulley at point of suspension; a weight (x), and part of weight (Y) passing over a pulley in a horizontal line, were added in such proportions till they produced an equilibrium, i. e. till the portion of platform (c) was made horizontal by the joint effects of the two weights x and Y.

The subjoined table shows in its several columns what the proportions of the weights (x, x^1, x^2, &c., and Y) should be, theoretically calculated, to produce equilibrium at the different points as the rods were successively attached; and it also shows what the actual weights were particularly applied in succession, as well as the collective results on the whole series, with the differences.

At the distance of 7 feet the oblique rod (a^1) was attached to a second piece of platform (c^1), with its weight of 56 ℔s., which latter was also connected to the piece (c) flexibly; the weight (x^1) appended to the rod (a^1) and weight (Y), increased till the equilibrium was produced, or both pieces of platform (c, c^1) were in a horizontal line. In like manner were all the obliques (a^2, a^3, a^4, a^5,) attached to the several portions (c^2, c^3, &c.) of platform, and the weights added and corrected: when the whole series was complete, the weight Y had attained its maximum. The table will show the differences between the actual weights (Y, Z, x^1, x^2, &c.) and the numbers on the plate, which are those mathematically calculated as due to the several rods and beam.

The result shows that the whole were increased slightly beyond the calculated amounts; but this may be attributed to the friction of the chains upholding the oblique rods, which passed over cast iron pulleys 9″ diameter. It will be observed, however, that the increase was proportional: thus the originally calculated weight (x^1) due to the oblique rod (a^1) was 74 ℔s., but, to produce equilibrium, required to be increased to 95, and the calculated total amount of Y was 406 ℔s., afterwards practically requiring 519; but the numbers 74 and 406, are relatively proportional, to 95 and 519.

To prove the proportions due to the chain links in connection with the rest of the parts, the oblique rods were severally disengaged from the pulleys, and attached to the chain as follows. The rod (a^5) was first attached to the centre link (b^5), the outer end of which was fixed to a chain passing over a pulley, and to which was appended weight x^6. The lower end of the link (b^4) was likewise attached to the junction of the two rods, and its upper end to a chain passing over a pulley with weight x^4 appended, the intermediate pulley and weight x^5 being removed. In this position was remarked the amount of the weights required to produce equilibrium, and what proportion x^4, which denoted the tension on link b^4, bore to the numbers mathematically calculated: the result of the whole is shown in the table, and the annexed Sketch, the position of the rods at this period: (See Fig. 19) (b^4), being a true resultant of b^5 and a^5. Each other link (b^3, b^2, &c.) was then added in succession, the weights (x^4, x^5, &c.) being withdrawn in turn, and that attached to the link under investigation being increased as the experiment approached the upper link (b), when the weight Z denoted the total tension on the upper link.

Thus was shown the separate tension on the oblique rods, the horizontal tension on longitudinal beam, and the tension on each link of the chain: the results, as compared with theory, are noted in the table, and are satisfactorily approximate to each other.

It was stated in the report of the Committee on the Ballee Khâl bridge, and referred to in the ninth paragraph of my statement on the resultant system, before alluded to, that the power of the longitudinal beam at the centre, added to the power of the centre link should, together, be nearly equal to the power of the upper link, so that whatever power was taken from the chains in the centre, should be compensated for in the longitudinal beam. Now the result of the experiment entirely coincides with that opinion, and confirms the view taken of this part of the construction. The total corrected amount of weight Z was 1086 lbs., and the sum of weights x^6 and Y, or $572+519=1091$ lbs.

Experiment the second, Fig. 2, was proposed by Colonel Forbes, on Mr. Dredge's extreme oblique principle, with the sole exception that the central portion of the roadway beam formed the horizontal connection between the first slanting links on each side of the centre, thus, in the Fig. 2, as before, c, c^1, c^2, &c., denote the platform, b, b^1, b^2, the chain, the lower link of which is attached near the centre to the longitudinal beam at c^3. In this position only can Mr. Dredge's theory of a vanishing strain existing in the centre link (N, dotted line) be granted; but at the same time the roadway beam must be equal (nearly) to the full section of iron in the upper link, as the result proved. The weights Z and Y were alone necessary for this experiment, the weights a, d, d', d^2, d^3, being, as before, $\frac{1}{2}$ cwt. each.

The span of this half curve was only 40 feet, yet it required 1242 ℔s. at Y, and 1302 ℔s. at Z, to produce equilibrium, being a greater weight than in the former experiment, in consequence of greater tension being called into action by the greater obliquity of the rods; and a proof that in Mr. Dredge's construction there is not iron enough in the centre of the longitudinal beam to resist the tension existing there. This experiment showed much more rigidity than the former one, being more powerfully acted on; but to have manufactured it sufficiently strong to resist the tension, would have entailed a heavier outlay than the former.

There is no doubt but that this construction of making the longitudinal beam act centrally as part of the chain would tend to stiffen the structure, and might simplify the details in small spans; but in large spans, where the centre link is of great substance, and with a double chain, practical difficulties occur which would render the centre link a necessarily distinct feature, and prevent its absorption into the roadway beam.

The reason why the chains are drawn tangent to the railing is to enable the railing to be placed centrally under the chains; for if the chains were tangent to the roadway, though there would be a decrease in the height of the standards, there would be a loss of 2 feet in width of platform; for with a wide chain dipping below the railing, the stanchions supporting it must be placed 1 foot on each side, within the central line of the chain, in order to avoid contact with it; and an extra 2 feet of platform is more expensive in its consequences on the amount of iron than an additional 4 feet of masonry on the standards.

Experiment 3rd, of which Fig. 3 is illustrative, was a construction on the resultant principle, similar to experiment 1, carried to a much larger extent. The Fig. 3, shows only one half of it, as it was an entire curve of 490 feet between the points of suspension, the lengths of the rods and beam, heights and distances, being to a full scale, whilst the sectional area of the iron was $\frac{1}{196}$th part of reality. The sections of the whole of the parts are given, and proof calculations that each was correctly proportional to the full sections of the actual bridge. The standards were formed of spars, firmly supported by struts in front* and stayed back with ropes and chains, the latter having tackle on them to correct the perpendicularity of the masts, should they yield to the load.

The horizontal beam was upheld by forty-four rods from the chain and six direct from each standard; the chain double, tapering in the centre to a power equal to $\frac{1}{5}$th the upper link.

The angle of the centre oblique rod 25°, and that of the one next the standard 38°; so that there was only a difference of 13° between the two extremes, divided amongst twenty-eight points, or a difference of tension between the extremes in the proportion of 2·63 to 1·62.

The deflection of the chain was equal to $\frac{1}{12}$th the span.

The section of the longitudinal beam at the centre, added to the section of the centre links, was equal to the sectional area of the upper links of the chain.

The whole of the experiment being, as before said, $\frac{1}{196}$th part of reality, is a model of the curve, which was designed for the Agra bridge, and the result of this experiment will go far to prove the correctness of the theory advanced.

The calculations show the proportional load for the experiment to be 1352 ℔s., at the rate of 120 ℔s. per square foot of platform, to be uniformly distributed over 56 points. This was done by slinging a basket at each point, and gradually loading them up to the amount of 57 ℔s. each.

When loaded with 24 ℔s. in each basket, or 51 ℔s. per square foot (exclusive of weight of experiment), the deflection in the centre, after the masts were made upright, was $1\frac{3}{4}''$ only in the centre.

With an additional load of 16 ℔s. per baskest, making in all 40 ℔s., or $84\frac{1}{2}$ ℔s. per square foot of platform, the deflection in the centre was $5\frac{1}{2}$ inches, and midway between the centre and standards, on one side $1\frac{1}{2}''$, and on the other $2\frac{1}{4}''$, on account of the greater flexibility of one mast than the other. When the full load of 57 ℔s. on each point, or

* Left out in drawing, to prevent confusion.

120 per square foot, was put on, the deflection was $13\frac{1}{8}$ inches in the centre. This load was allowed to remain on 3 days: it was subsequently unloaded and re-loaded several times with nearly the same results; and after the lapse of 17 days from the period of its first being loaded, when all the weight was taken out of the baskets except 24 ℔s., which is proportional to the weight of the suspended platform of the real bridge without the traffic weight, the longitudinal beam sprang up to within $\frac{3}{4}$ths of an inch of the horizontal line on which it was first constructed.

Thus was this very extended curve, formed of such exceeding slender material, not any of which could be proved before it was put together, found equal, proportionally, to the greatest amount of the traffic load that could on any extraordinary occasion come on the bridge, without derangement of any of its parts: the combination appeared as stiff under the load as could reasonably be expected with such slender wires, and fully bore out the results detailed in experiment No. 1, and the mathematical demonstration of the powers of the bridge, as set forth in the specification of the Agra bridge.

Subsequent to the above detailed loading, I continued adding weight to the baskets, and correcting the masts as well as the power of the tackle enabled me to do, till the weight in each baskest amounted to 81 ℔s., when the longitudinal beam was torn asunder at the distance of 25 feet from the centre, and the whole immediately buckled up.

The breaking weight was therefore 174 ℔s. per square foot of platform, or a tension of 15 tons per square inch of that slight material, the weldings of which were with difficulty made, and the strength of which there was no means of proving.

I cannot imagine any further proof to be necessary of the efficacy of such a system as has been proposed, manifestly having for its object the avoidance of the defects of both the uniform and extreme oblique system, combining the strength and solidity of the former with the rigidity, economy, and more scientific construction of the latter.

In this construction, admitting the action of tension in every direction, and where the rods and bars are drawn in the direction of their length, the full amount of tension that can possibly affect every part of the structure can be accurately ascertained, and thus certain data are afforded from which to proportion the sectional areas of every part of the bridge.

Scantlings of Rods of Experiment No. 3.

Each chain.	Upper link	$\frac{15}{32}$	of one inch.
	2 ,,	$\frac{29}{64}$	
	3 ,,	$\frac{28}{64}$	
	4 ,,	$\frac{27}{64}$	
	5 ,,	$\frac{26}{64}$	
	6 ,,	$\frac{25}{64}$	
	7 ,,	$\frac{24}{64}$	
	8 ,,	$\frac{23}{64}$	
	9 ,,	$\frac{22}{64}$	
	10 ,,	$\frac{20}{64}$	
	11 ,,	$\frac{19}{64}$	
	12 or centre,	$\frac{18}{64}$	

Oblique rod $\frac{1}{8}''$ diameter.

Longitudinal beam at centre $1'' \times \frac{3}{16}''$.

,, ,, 7th space from centre $1'' \times \frac{9}{64}''$.

Explanation of the relative proportion between the Experiment and the real Bridge.

Full section of two chains, one side of the real bridge.

Upper link, 17 bars $2'' \times 1'' = 34'' \times 2'' = 68$ square inches.

Diameter of experimental upper link, $\frac{16}{32}$ of one inch.

Area of which ·178 and ·178 × 2 ch. = ·346 section of two chains.

·346 × 176 = 67·8, or section of real bridge.

Area of platform, real bridge, 468 × 11 = 5148 square feet:

5148 × 120 = 617760 ℔s. on real bridge.

$\frac{617760}{196} = 3156$ ℔s. total load for experiment.

$\frac{3152}{56} = 57$ ℔s. on each point of experiment.

Area of oblique rods of real bridge 2·405 each.

Diameter of rods of experiment $\frac{1}{8}''$ or sectional area ·012:

·012 × 196 = 2·352, or very nearly the section of real bridge.

Sectional arc of longitudinal beam of real bridge at centre, 37 inches; remainder 27″ beyond the 7th oblique rod.

Sectional of experimental beam at centre $1'' \times \frac{3}{16}'' = \cdot 188$; and $\cdot 188 \times 196 = 36\cdot 848$, or nearly the section of real bridge.

Remainder of section, $1'' \times \frac{9}{64}'' = \cdot 141$ at the 7th rod :

$\cdot 141 \times 196 = 27\cdot 636$, as nearly as possible the section of real bridge.

Table explanatory of the previously calculated theoretical tensions, and subsequently practically proved results, on an experiment undertaken to test the Taper Chain "Resultant" system.

	Oblique rod forces.			*Chain link forces.*		*Total tension horizontal line.*				*Total tension upper line.*			
	Previously calculated.	Practical result.	Difference.		Practical result.		Previously calculated.	Practical result.	Difference.		Previously calculated.	Practical result.	Difference.
x or a	68			b	814								
or a^1	74	95	21	b^1	750								
x^2 or a^2	81	102	21	b^2	678								
x^3 or a^3	92	107	25	b^3	596	**Y**	406	519	113	**Z**	814	1068	272
x^4 or a^4	104	132	28	b^4									
x^5 or a^5	112	145	33	b^5									

Bal'amy's translation of the History of Tabary, and Ghazzály's History of the Prophets.—By A. Sprenger, *Esq. M. D.* (*Communicated by* H. M. Elliot, *Esq. Vice-President.*

Messrs. Silvestre de Lacy and Dubeux complain justly of the great incorrectness of the copies of the Persian translation of Tabary, and their discrepancy from each other, which is so great that little reliance can be placed on the book; that which is affirmed in one copy is not seldom contradicted in another. I thought this circumstance might be owing to a difference of original editions made by the author himself; a comparison of several copies however does not bear out this hypothesis; the various readings cannot be reduced to a certain number of original texts.

If we consider the age when Tabary was translated (between A. H. 350 and 366) and the comparatively modern language of the copies which we possess, another hypothesis suggests itself, viz. that these corruptions and discrepancies are owing to attempts on the part of the copyists to improve the obsolete expressions of the original. Though I have never met with a very ancient MSS. of Bal'amy's Tabary, this supposition has been confirmed by the discovery of a work of Imám Ghazzály (who died A. H. 505), which I believe has hitherto escaped the attention of bibliographers.

In the Moty Mahal library of the king of Oudh is a Persian MS. in 4to. of 250 pages, with the following title page written in the same hand in which the text is written:

كتاب قصص الانبيا صنفه الامام العالم العلامة حجة الاسلام هادي الانام سيد الحكماء سلطان العلماء جامع العلوم وجاوي المناقب محرز الفضائل زين الدين ابو حامد محمد بن (sic) الغزالي

"History of the prophets, compiled by the learned Hojjat al-islam Zayn al-dyn abú Hámid Mohammad, the son (sic) of Ghazzály (sic)." The MSS. is executed in a very beautiful naskhy character, and is the most ancient, and one of the most correct *Persian* MSS. that I have seen. It was probably written in the sixth century of the Hijrah, and abounds in peculiarities in spelling, as will appear from the extracts given below.

On comparing this book with the Persian translations of Tabary it appears that the latter embodies the whole of the former. It is indeed likely that the History of the prophets of Ghazzály is nothing more than an abridged edition of Tabary. This seems to be borne out by the circumstance that the invocation of God and of the prophet,* with which every Mohammadan book begins, is literally the same in our copy of Tabary and in Ghazzály, only the words قال ابو جعفر محمد بن جرير الطبرى are omitted by the latter. In the same copy of Tabary we find the beginning of the first chapter of Ghazzály preceded by the words "know that Abú Jáfar Mohammad b. Jaryr Tabary says in the beginning of his work." But in another copy of Tabary, this passage is wanting, and there is a different invocation† of God and the prophet. On the other hand, as the Persians have taken so great liberties with their translation of Tabary, it is possible that they have inserted the whole of Ghazzály's book into it.

Be this as it may, this valuable MSS. enables us to restore a large portion of our copies of Tabary; moreover it is of great intrinsic value; it contains the passages of the Korán alluding to the ancient prophets, most skilfully arranged and connected, and illustrated in a natural manner and with great perspicuity. It is the only book which gives us a clear view of *Mohammad's* notions of the prophets; all other Mohammadan books on the subject are filled with fables, which not only belong to a later time but to different countries. Here is the index of Ghazzály's history,‡ which differs but little from that of Tabary.

1. Discussion on the object of the creation, fol. 4.

2. Tradition of 'Abd Allah b. 'Abbás from the prophet on the description of sun and moon, fol. 7.

3. Discussion on the duration of the world, fol. 9.

4. Discussion on the creation and in how much time it was accomplished, 10.

5. On the first inhabitants of the world, 14.

* It begins: الحمد لله الاول قبل كل اول والاخر بعد كل اخر والدايم الح

† It begins: الحمد لله العلي الاعلى الوافي من الى الوفي ذي الاسماء الحسني الح

‡ An index to Tabary is contained in the Zeitschrift der Detschen Morgenl. Gesellsch. II. 2. p. 159. See also DuCrux's translation of Tabary.

40. Arrival of Joseph's brothers, 66.

41. Job, 72.

42. Sho'ayb, 74.

43. Moses, 78.

44. Birth of Moses, 79.

45. Flight of Moses to Madyan, 83.

46. Prophetic mission of Moses, 85.

47. God speaks to Moses, 85.

48. Moses goes to Egypt to Pharaoh, and with Aaron he conveys to him the message, fol. 89.

49. Pharaoh is drowned and the Israelites leave Egypt, 95.

50. Moses goes to speak with God and the Israelites worship the golden calf, 99.

51. History of the cow and the carnage among the children of Israel, 106.

52. Moses and Khidhr, 109.

53. Moses and the Israelites leave Egypt; they come into the country of the giants, whom they fight at Jericho, in the Balqá and at Jerusalem, 112.

54. Death of Moses and Aaron in the desert, 115.

55. Joshua heads the Israelites and fights the giants, 116.

91. The Table, 119.

92. The town on the sea shore, 119.

93. Christ's ascension to heaven, 120.

94. Death of the Virgin Mary, and execution of John Baptist, 122.

95. Kings of the Romans, from Christ to Mohammad, 122.

Unfortunately the copy is defective and gone; the most important chapters are wanting, the lacuna is after chapter 55. I give here the heads of the wanting chapters according to the index of the book.

56. Qárún and Moses.

57. The kings of the Israelites after Moses and the march of Manújehr.

58. Kaykobád.

59. The prophet Hizqyl.

60. The prophet Elyás.

61. Alyása' and the kings of the Israelites after him.

62. Samuel.

63. Samuel and Tálút.

64. War of Tálút with Jálút (Goliath). David slays Jálút.

65. Tálút, his intention to kill David and how God leads him into his own snare.

66. David.

67. Solomon.

68. Solomon and Bilqys.

69. Solomon and the Devil; his temptation; an image is put on his throne (Korân 38, 33.)

70. Death of Solomon.

71. The Ant in the story of Solomon and David.

72. The Horses in the story of Solomon and David.

73. Rehoboam son of Solomon.

74. Kishen and Zarj, the king of India.

75. The prayer whieh was acceded to.

76. Kings of the Israelites.

77. King Lohrásp.

78. His son Gushtásp.

79. Kings of Yuman after Solomon.

80. Buhman and his son Dárá whom he begat by his daughter Homáy.

81. The elder Dárá.

82. His son the younger Dárá.

83. Dzú al-Karnayn (Alexander) and his reign.

84. Greek kings after Alexander; the kings of the Satrapies.

85. Birth of Mary and how she was destined to serve God (Korân 3, 31.)

86. Birth of John Baptist.

87. Birth of Christ.

88. Flight of Mary and Christ.

89. Zacharias put to death; prophetie mission of his son John.

90. Prophetic mission of Christ.

History of Húd.

From the time of Noah to the time of Abraham, which is a space of one thousand two hundred years, there was no prophet except Húd, whom God sent to the 'Ádites and Cálih, whom he sent to the Thamúdites. 'Ád and Thamúd were not two kings but two tribes descended from Shem the son of Noah. The father of our tribe was 'Ád the son of Uz b. Arem b. Shem b. Noah. The father of the other tribes was Thamúd b. Gether b. Arem b. Shem b. Noah. 'Ád had many children who were collectively called 'Ád ('Ádites). Thamúd had also many children and they were called Thamúd (Thamúdites). In the Korân the people of 'Ád are called 'Ád and Iram (Aremites). It is said in the Korân (86, 3). "Dost thou not see how thy Lord acted with 'Ád and Iram." Sometimes they are called by this name and sometimes by the other. Tabary observes in this book that the commentator of the Korân and the learned said: the reason why it runs in the Korân "their brother and not his brother" is that under the name of Thamúd the tribe of Thamúd is to be understood "To Thamúd we sent their brother Cálih" and not "his brother."

The 'Ádites and Thamúdites lived in the steppes of the Hijáz between the territory of Makkah and Syria. The country of the 'Ádites was near to the country of Makkah, but the country of the Thamúdites was farther from Makkah (this is precisely the position which Ptolemy assigns to his Tamuditæ and Oaditæ. The 'Ádites seem to have been still existing in the second century after Christ. All Mohammadan authors besides Tabary and Ghazzály say that the 'Ádites lived in the uninhabitable desert of Ahqáf, the latter inhabited a district called Hijr, which is on the frontier of Syria on the extremity of the steppes of the Hijaz. "The inhabitants of Hijr have accused the prophets of falsehood." The inhabitants of Hijr in this passage are the Thamudites. The 'Ádites and Thamúdites were the descendants of cousins and descended from Iram, but the 'Ádites flourished earlier and the Thamúdites by two hundred years later. The 'Ádites are also called the first 'Ádites and the Thamúdites are called the second 'Ádites. In the Korân whenever one of the two is mentioned the other is mentioned as well, and the name of the 'Ádites stands first, and that of the Thamúdites last: as (26, 123.) "The 'Ádites accused the prophets of falsehood," and subsequently (v. 141), the Thamúdites are mentioned again (41, 14). "As to the 'Ádites they were overbearing on earth," and after that (verse 16) "and as to the Thamúdites, &c." In another passage it is said the 'Ádites and the Thamúdites. The same is the case wherever they are mentioned.

The 'Ádites were stronger in body and more powerful than the Thamúdites. There was no nation on earth equal to the 'Ádites in tallness or strength. Every man was twelve spans high and some of them were so strong that if they struck the foot on the dry ground they would sink into it to the knee. They built houses in their country which were in keeping with their strength and of almost everlasting construction up to this day: if you see a strange building it is called 'Ádian "Iram dzát imád, &c." It is said in the Korân "Do you not know how God has acted with the 'Ádites, who were the Lords of 'imád." 'Imád is a pillar and the meaning of the passage is that they were in stature like pillars; every one of them was like several pillars in height and strength. In another passage they are compared with palm roots "they are like palm roots strewed about on the ground."

They were idolators: God sent Húd to them who was the son of their uncle; his name in Hebrew is Gháther. In the Korân he is called their brother "their brother Húd." Brother has a double meaning, brother by relationship and brother in faith. Húd was their brother by relationship and not by religion. Húd called them to God saying: "O people, worship God, you have no God besides him." Proud of their strength they said to him "Who is stronger than we?" They were fifty thousand men strong, and then therefore they said "what tribe is more numerous than we?" "Do you not see that God who has created them is stronger than they are?" Húd was incensed and said "Do you build a landmark on every place to direct yourselves? And do you erect strong edifices hoping that you may continue to live for ever," "and if you are at feud you are at feud with giants; you seize them without mercy and you do not let them loose before they are dead, fear God and obey him." After this Húd enumerated to them the bounty of God. "Fear that God who has given you what you know, who has given you cattle, children, gardens, and springs of water." Cattle are mentioned first in this passage, because the wealth of the sons of the desert consists in the sheep, cows, camels and the like. The reason why first their property is mentioned and then their children, is that children may be a misfortune, and a rich man can easily obtain children. In another passage it is said "wealth and children." Here again wealth is placed before children, because wealth is most esteemed with men. Húd preached fifty years but they answered him "it is of no consequence for us whether you preach or not." "O Húd, thou assertest that these our Gods are no Gods, but you do not prove it, and therefore we will not give up our Gods on thy telling us to do so, and we will not obey thee." "We are certain thou art mad, and these our Gods, whom thou dost not worship have made thee mad."

In short Húd preached to them fifty years and no body believed in him, and those who did believe in him held their faith secret, and did not show their faith openly. After a long time Húd despaired of success. God knew that no one believed, and decided on punishing them; their spring of water which we have mentioned, became dry, and all their cattle died; they had three years no rain; they suffered of draught. It was the habit in the whole of Shám to go to Mukkah and offer there sacrifices and invoke God, though the inhabitants of Shám were unbelievers. At that time not a trace of the Kábah was left, having been destroyed by the deluge, and it was not rebuilt before the time of Abraham. This prophet (who lived later than Húd) raised the temple again. Yet the unbelievers knew that the soil of Makkah was sacred heaven, and they had preserved tradition, from the time previous to the flood, that there had been the house of God. The sacred territory was therefore always esteemed, and every one who was in need was aware that none but the God of heaven could help him. If they wished that a sick person should recover, or if a prisoner was in the hands of the enemy, or if there was an oppressor with whom they could not cope, they went to the spot on which now Makkah stands, offered sacrifices and invoked God on the top of that hill. The cause of this was that God never left the world without evidence of his existence, nor was mankind ever in complete ignorance. It is true there was no prophet in those days who showed to mankind the road, but God made the sacred territory the proof of his existence, for as they were there assisted in their needs, and as they saw these miracles, they knew that there was a God besides those idols and that he does all these works. This was the proof of God for mankind which left no excuse for an infidel who might say I did not know better, or I have not heard the name of God, there was a proof of the existence of God and it was just that those who would not believe should be thrown into hell.

When the 'Ádites were in great distress they said: Let us send messengers and sacrifices into the sacred territory that they may pray and that we may obtain rain. They sent a man of the name of Loqmán. He was the eldest, the most influential, and the strongest man among them, and was nearest to 'Ád in descent: he was Loqmán son of Loqaym and grandson of 'Ád, and was secretly united with the prophet Húd. They also sent another man of the name of Marthad b. Sa'd who professed the religion of Húd and who was equally one of their chiefs; there was another man with them of the name of Qayl, who was an unbeliever and an adversary of Húd, but he was the greatest chief of the three, they sent these three men with much cattle, sheep, cows and camels, and they gave them orders to sacrifice them at Makkah and to pray for rain from God. The distance to Makkah was three days' journey, Húd said to the 'Ádites: "O people, believe in me that God may give you rain if you want it. Pray God for pardon, then repent your sins and he will give you fair enjoyments, and he will increase your strength." But they shut their ears to the admonitions of Húd and dispatched these three men to the country of Makkah. They had relations at Makkah who lived on the hill. The tribe of Mo'awiyah b. Bokr received them as guests, and told them to enjoy three days their hospitality and then to attend to the object of their mission; they spread the tables, gave them wine to drink and amused them with the singing of slave girls. One whole month they spend in drinking and did not think of their tribe. After the lapse of this time their hosts became mindful that they had forgotten their tribe, and they were sorry first, for the 'Ádites were their relations, yet they were ashamed to turn them out of their houses and make them attend to their work. They therefore taught a song to the slave girls that they might call to their mind in music the drought of their country. As soon as the messengers had heard the singers mention their tribe their memory was awoke and they said we have committed a great error in forgetting our countrymen: they broke up in order to perform the sacrifices. Marthad and Loqmán who believed in Húd professed their faith and said to Qayl who was an unbeliever, if our tribe was to believe in Húd, it would rain by itself and there would be no need of these sacrifices. Qayl knew that they believed in Húd; he was not afraid of the destruction of the tribe, and left them and went on the top of the hill; the place for sacrificing was on the hill of Minà. He killed the sacrifices turned his face towards the heaven and said, O God of heaven, thou knowest that I am come here in need; my need is not sickness from which I wish to be relieved, nor captivity from which I want liberation, but I want rain for my tribe who are nearly perishing from thirst. He thus spoke and prayed until three clouds made their appearance in the air, one was white, one red, and one was black. A voice came from the wind: Choose which of the three clouds thou wantest, that it may go to thy tribe! He said to himself I know that this white cloud is dry and that it contains no rain; I do not know what there is in the red cloud; but in the black cloud is rain, for if a black cloud comes its rains. He therefore exclaimed I wish that the black cloud should go to my tribe. In this black cloud was the wind of destruction. God ordered the angels of destruction to bring the black cloud to the country of the 'Ádites. Qayl descended from the hill and went to his two companions, and said a black cloud came with rain and I sent it to my tribe, saying this he sat down with them to drink; the cloud went to the 'Ádites and it was preceded by a wind. When the cloud came near they were delighted that wind, clouds, and rain were coming, "and when they saw it coming to their valleys they said this will bring rain." But Húd knew that it was the punishment; for God had informed him thereof and he said, "On the contrary this is what you have brought untimely upon yourselves; it contains wind by which a painful punishment will be inflicted upon you." When it was over their heads it stopped, and a sterile wind broke forth from it—"And in the 'Ádites when we sent against them a sterile wind"—'Aqym (sterile) is that from which there flows no advantage. Wind may be very useful after this world, it brings water for trees and makes them fertile, it propels ships on the sea, it carries sweet odors, it cools water, but a wind which has none of these advantages is called 'Aqym (sterile). In another passage of the Korân the wind is called 'Áty (destructive)—"As to the 'Ádites they were destroyed by a cold and destructive ('Áty) wind." All the quadrupeds which they had, were taken up from the ground by the wind and carried into the air, from whence they fell to the ground and were dashed to pieces. "Whatever it touched was reduced to rotten bane." When they saw this they said, have patience, for after the wind it will rain. They went out of their houses into the open field were they sank into the ground to their thighs and stood there with great courage. Húd thought they were coming to him in order to express their wants, and that they would believe in God but they did not believe. The wind came and took every one of them up from the ground and carried him up into the air from whence he fell to the ground and died. They were strewed over the ground like trees, "as if they were palm trees thrown on the ground;" "they are like the roots of torn up palm trees," whoever fled was overtaken by the wind thrown to the ground and killed. The women had remained in their houses, they were equally raised from the ground and struck against the walls until they were dead. This wind lasted a whole week. "God caused the wind to assail them seven nights and days successively." Not a soul of them remained alive except Húd and those who believed in him: they suffered no harm from the wind. "When we sent the punishment we saved in our mercy Húd and those who believed, we saved them from the heavy punishment." The three men sent to Makkah were during all this time in that city feasting and remained ignorant of the fate of their tribe, until a man of another tribe who had passed the valley of the 'Ádites and had seen them, arrived at Makkah and give intelligence that they had all perished except Húd and those who believed. The two believers rejoiced, but Qayl, who was an unbeliever, was sorry; he got up and ascended the hill of Minà; Loqmán and Marthad accompanied him, and said to him, believe in Húd, to avoid thy destruction. He answered, I have no object in life since my friends are dead, and raising his head he exclaimed: O God of heaven, if it is true that my tribe is destroyed, destroy me as well. A wind came which took him up from the top of the mountain, threw him on the ground, and killed him. The two men who believed in Húd heard a voice which proeeeded from the hill: "Whatever each of you wisheth ye shall have." Marthad b. Sa'd said, I wish that I should have a sufficient quantity of wheat to be able to afford to eat wheaten bread all my life. He obtained it; he descended from the hill and went to Makkah where he remained till he died. Loqmán said, I wish to have a long life. He heard a voiee, saying: However long thou mayest live thou must die in the end. He answered, grant it! The voice said thou shalt have the life of seven vultures! He also settled at Makkah. He used to visit the top of a hill where the vultures laid their eggs and watch the chickens. When they came from the egg he took them away and took care of them.

Thus he kept seven vultures in succession, the last was called Lobad. Loqmán and Lobád died at the same time. Tabary observes that a vulture lives eighty years; but according to other accounts, they live longer. Húd remained with his follower in the country of 'Ád and lived fifty years after the 'Ádites and died at an age of 150 years. There was no prophet for one hundred years after Húd until the time of Cálih and of the Thamúdites. There were only kings, and every one had a different religion, one was an idolater, another was a fire-worshipper, &c. This continued to the time of Cálih.

Ghazzály.

١ القول في المعنى الذي خلق الله الخلق من اجله *

٢ حديث عبدالله بن عباس عن النبي عليه السلام في صفة الشمس و القمر *

٣ القول في مقدار مدة الدنيا *

٤ القول في صفة الخلايق وفي كم كان ذلك *

٥ ذكر اول من اسكنه من البشر *

٦ ذكر سجود الملايكة لآدم عليه السلام *

٧ ذكر مخدعة ابليس لآدم و حوا *

٨ ذكر هبوط آدم من الجنة *

٩ ذكر حج آدم عليه السلام *

١٠ حديث قتل قابيل لهابيل *

١١ القول في اخراج الذرية من صلب آدم *

١٢ نبوت آدم و ابنه شيث *

١٣ سوال ابو ذر غفاري وفات آدم *

١٤ ذكر شيث بن آدم و اولاده من بعده ومن ملك *

١٥ ذكر اول من عبد النار و اتخذ المعارف *

١٦ قصة ادريس عليه السلام *

١٧ قصة نوح عليه السلام *

٦٥ حديث الياس النبي *

٦٦ حديث اليسع و الملوک الذين كانوا من بعده في بني اسرائيل *

٦٧ حديث اشموئيل النبي *

٦٨ حديث اشموئيل و طالوت *

٦٩ حديث حرب طالوت مع جالوت و قتل داؤد جالوت *

٧٠ حديث طالوت و ماهمّ به من قتل داؤد و كفاه الله شره *

٧١ حديث داؤد *

٧٢ حديث سليمن بن داؤد *

٧٣ حديث سليمن النبي مع بلقس *

٧٤ حديث سليمن مع الشيطان الذي فتن به والقي على كرسية *

٧٥ وفات سليمن *

٧٦ حديث النمل من اخبار سليمن بن داؤد *

٧٧ حديث الخيل من اخبار سليمن بن داؤد *

٧٨ حديث رخبعم بن سليمان بن داؤد *

٧٩ حديث كيشان و زرج ملك الهند *

٨٠ ذكر دعاى مستجاب *

٨١ خبرالملوک الذين ملكوا على بني اسرائيل *

٨٢ ذكر بهراسب الملک *

٨٣ ذكر كشتابت بن بهراسب *

٨٤ حديث ملوک الحق من بعد سليمان بن داؤد *

٨٥ حديث بهمن وابنه دارا من ابنته هماى *

٨٦ حديث دارا الاكبر وملكه *

٨٧ حديث داراء الاصغربن داراءالاكبر *

٨٨ حديث ذوالقرنين وملكه *

۸۹ حديث الملوک اليونانيين من بعد ذوالقرنين و اخبار ملوک الطوايف *

۹۰ مولد مريم وتحريرها *

۹۱ حديث مولد يحيى بن زكريا *

۹۲ حديث مولد عيسى *

۹۳ حديث هجرة مريم وعيسى *

۹۴ حديث مقتل زكريا و نبوة ابنه يحيى *

۹۵ حديث نبوة عيسى *

The following extracts will enable the reader to compare the ancient text of Tabary as preserved by Ghazzály, with the modern text, as found in our copies of Tabary. I still hope that a copy of the original will be discovered in India or in Persia.

Text according to our copies of Tabary.	*Text according to Ghazzály.*
و درين ايام پيامبر نبود اندر جهان	واز وقت نوح تا بوقت ابراهيم بدين
مگر هود پيغامبر وصالح پيغامبركه	هزار و دو بست سال درپيغامبري
هود را عليه السلام بسوى قوم عاد	نبود مگر هود كى او را سوى قوم عاد
فرستاد خداى تعالى وصالح عليه السلام	فرستاد ايزد تعالى و صالح را سوى
را بسوى قوم ثمود وابن عاد و ثمود	قوم ثمود فرستاد و عاد وثمود ملك
نه ملك بودند ليكن دوقبيله اند از	نبودند وليكن دوقبيله بودند ازفرزندان
فرزندان سام بن نوح عليه السلام يك	سام بن نوح و يكى قبيله را پدر عاد
قبيله را نام پدر عاد بن عوض بن سام	بن عُوض بن ارم بن سام بن نوح بود
بن نوح عليه السلام و اين هردو را	ويكى قبيله را پدر ثمود بن حابر بن
فرزندان بسيار بودند وهرقبيله را بنام	ارم بن سام بن نوح بود پس عاد را
پدر خواندندى چنانكه بني تميم	فرزندان آمدند بسيار همه قبيله راعاد
وبني اسد پس خداى تعالى آن همه	خواندندى وثمود را فرزندان آمدند

Text of Tabary.

قوم را بعاد خواند و گفت وَالیَ عَادٍ
اَخَاهُمْ هُوْداً اخاهم گفت و نه گفت
اخاه ازانکه یك تن را نخواست وهمه
قبیله را خواست چون ایشان را پدر
عاد بود خدای تعالی ایشانرا هم بعاد
خواند وهم بارم و ایدون گفت اَلَمْ تَرَ
کَیْفَ فَعَلَ رَبُّكَ بِعَادٍ اِرَمَ و هردو پدر
ایشان بودند و همچنین ثمود را نام
برد و قوم ثمود را خواست چنانکه
گفت وَ اِلَی ثَمُوْدَ اَخَاهُمْ صَالِحًا عاد و
ثمود هردو گروه بیکجای نزدیك بودند
ببادیه حجاز میان زمین مکه و شام
زمین عاد بمکه نزدیکتر بود و زمین
ثمود زمینی بود نام او حجر وان بطرف
شام بود بکنار بادیهٔ حجاز چنانکه
خدای تعالی گفت وَلَقَدْ کَذَّبَ اَصْحَابُ
الْحِجْرِ الْمُرْسَلِیْنَ و اصحاب حجر قوم
ثمود بودند وقوم ثمود وقوم عاد هردو
گروه عم زادگان بودند وثمود از فرزندان
ارم بن سام بن نوح بودند علیه السلام
لیکن قوم عاد بیشتر بودند وقوم ثمود
کمتر ومیان ایشان دوبست سال بود
وعاد را عاد اول خواندند و ثمود را ثمود

Text of Ghazzály.

بسیار همه قبیله را ثمود خواندندی
وخدای تعالی قوم عاد را بعاد بازخواند
وهم بارم وگفت قوله تعالی اَلَمْ تَرَ کَیْفَ
فَعَلَ رَبُّكَ بِعَادٍ اِرَمَ گهی بدین باز
خواند وگهی بدان ومحمد جریر گوید
بدین کتاب اندر کی مفسدان وعلما
گفته اند تا بدانی کی چرا گفت اخاهم
ونگفت اخاه و هم چنین نیز ثمود را
نام برد وقوم ثمود را خواست قوله تعالی
وَاِلَی ثَمُوْدٍ اَخَاهِمْ صَالِحًا ونگفت اخاه
عاد وثمود هر دو گروه ببادیهٔ حجاز
بودندی میان زمین مکه و زمین شام
وزمین عاد بمکه نزدیك بود وزمین
مکه از ثمود دورتر بود و بزمینی بود
نام او حجر وبرطرف شام بود بکنارهٔ
بادیهٔ حجاز قوله تعالی وَلَقَدْ کَذَّبَ
اَصْحَابُ الْحِجْرِ الْمُرْسَلِیْنَ واصحاب
الحجر قوم ثمود بودند وثمود وعاد
هردوگروه عم زادگان بودند وازفرزندان
ارم بودند ولیکن قوم عاد پیشین بودند
وقوم ثمود بسین ومیان ایشان دوبست
سال بود وعاد را عاد اول خواندند وثمودرا
عاد الثانی خواندند و در قران هرجا کی

Text of Tabary.

ثاني و چون بقران اندر نگري هر كجا
حديث ايشان ياد كرد نخست عاد را
ياد كرد پس ثمود را و اَيدُون گفت
كَذَّبَتْ عَادُ الْمُرْسَلِيْنَ وآنكه گفت ثمود
و ديگر جاى گفت فَاَمَّا عَادُ فَاسْتَكْبِرُوْا
فِي الْاَرْضِ وعاد از ثمود قوي تر بودند
بخلق و نيْرُوْ وبجهان اندر خلق نبود
ببالا ونيرو و قوم عاد و هر دو مردى
را دوازده ارش بالا بود و چندانى
نيرو بود كه پاى بر زمين برزندى
تا زانو برفتى وبدان زمين اندر بناها
كردند چنانكه جا و دانگى باشد و تا
امروز هرجا كه بناى بزرگ است
و قوي است انرا بناى عاد ميخوانند
و هر مردى كه بزرگ و قوي بود انرا
عاد ميگويند چنانكه گفت جلّ و علا
اَلَمْ تَرَ كَيْفَ رَبُّكَ بِعَادٍ اِرَمَ و معنى
اَلَمْ تَرَ بسمع باشد بقول مفسران گفت
نشنيدي يا محمد كه خداى تعالى
بقبيله ارم ذاتِ العماد چه كرد خداوند
ستون بودند وستون ازبالاهاى و راز
ايشان خواست گفتا هريكى ستونى
بودند ازبالا و قوت وجاى ديگر ايشانرا

Text of Ghazzály.

حديث ايشان آمده است هر دو را بايك
ديگر ياد كنند نخست عادرا پس ثمودرا
قوله تعالى كَذَّبَتْ عَادُ الْمُرْسَلِيْنَ وانگاه
گفت ثمود قوله تعالى فَاَمَّا عَادُ فَاسْتَكْبِرُوْا
فِي الْاَرْضِ پس گفت و اما ثَمُوْدُ وگفت
وعاد را وثمودا وهر كجا ايشانرا ياد
كرده است وعاد از ثمود قوي تر بود
بخلق وبنير وتر وبجهان خلقى نبود
ببلا ونيروى قوم عاد وبالاى هرمردى
دوازده ارش بود چندان نيرو داشتى
كى پاى بر زمين خشك زدى تا زانو
بزمين فرو بردى و بدان زمين خويش
اندرخانها كردند اندرخوردشان چنانكه
جاويدان باشد از قوت بنياد وامروز
هر كجا بنيادى استوار تر بينى انرا
عادى خوانند قوله تعالى اِرَمَ ذاتِ
الْعِمَادِ الَّتِيْ لَمْ يُخْلَقْ مِثْلُهَا فِي الْبِلَادِ
گفت نشنيدي كى خداى عزوجل چگونه
كرد بقبيله عاد خداوندان عماد وعماد
ستون بود يعنى كى بالاى ايشان
بستون مي ماند و هر يكى چند ستون
بودند از بالا و قوت و جاى ديگر
ايشانرا بخر ما نيان مانند كردند

Text of Tabary.

به خرمانیان نسبت کرد و اَیْدُوْنَ گفت
کَاَنَّهُمْ اَعْجَازُ نَخْلٍ خاوِيَة پس بدرازي
وقوت ایشانرا به خرمانیان و ستونها
مانند کرد و از ذات العماد قبیله را
خواست پس گفت اَلَّتِي لَمْ يُخْلَقْ
مِثْلُهَا فِي الْبِلَادِ هم قبیله را خواست
که چون ایشان خلق نبود بر زمین
و ایشان بت پرست بودند و بدان
داشتند بسیار و خدای تعالی هود
علیه السلام را بایشان فرستاد بپیامبري
و هود علیه السلام پسر عم ایشان بود
و از فرزندان نوح علیه السلام و هود
بزبان تازي است و بعبراني عابر بود
بن شالخ بن ارفخشد بن سام نوح
علیه السلام و خدای تعالی ایشانرا
برادر هود خواند و ایدون گفت اَخَاهُمْ
هُوْدًا و برادران از دوگونه بودند یکی
بقرابت برادردر دین وهود علیه‌السلام
ایشانرا بخدای خواند و گفت يَا قَوْمِ
اَعْبُدُوا اللّٰهَ مَا لَكُمْ مِنْ اِلٰهٍ غَيْرُهُ گفت
خدایرا پرستید و بت مپرستید که
شما را جز حق سبحانه تعالی خدای
نیست واگر نه پرستید شما را عقوبت

Text of Ghazzály.

گفت كَاَنَّهُمْ اِعْجَازُ نَخْلٍ خَاوِيَةٍ وبت
پرست بودند خدای تعالی هود را
بایشان فرستاد و هود پسر عم ایشان
بود و بعبراني نام او غابر بود و در
قران برادرشان گفت اَخَاهُمْ هُوْدًا و
برادر دو کس را گویند برادر بقرابت
و دیگر برادر در دین وهود بقرابت
برادربودند بدین وهود ایشان را دعوت
کردو بخدای خواند وگفت قوله تعالی
يَا قَوْمِ اَعْبُدُوا اللّٰهَ مَا لَكُمْ مِنْ اِلٰهٍ غَيْرُهُ
گفت خدای عز و جل را بپرستید کي
شمارا جز از و خدای دیگر نیست والّا
شمارا عذاب کند ایشان بدان زور ونیروی
خویش فریفته شدند و گفتند مَنْ
اَشَدُّ مِنَّا قُوَّةً از ما قوي تر کیست کی ما را
عذاب تواند کردن و پنجاه هزار مرد
بودند گفتند و از ما بیشتر کیست
بشمار قوله تعالی اَوَ لَمْ يَرَوْا اَنَّ اللّٰهَ
الَّذِي خَلَقَهُمْ هُوَ اَشَدُّ مِنْهُمْ قُوَّةً یعنی
ندانست کی آن خدای کی مر ایشانرا
آفرید قوي تر است پس هود ایشانرا
عذاب کرد و گفت اَتَبْنُوْنَ بِكُلِّ رِيْعٍ آيَةً
تَعْبَثُوْنَ وَ تَتَّخِذُوْنَ مَصَانِعَ لَعَلَّكُمْ

Text of Tabary.

کند ایشان بقوت تن فریفته شدند و
گفتند مَنْ اَشَدُّ مِنَّا قُوَّةً ازما قوي تر
نیست که ما را عذاب کند و عدد
ایشان بیش از پنجاه هزار مرد بود
و گفتند کیست از ما قوي تر و بیشتر
که ما را عذاب کند خدای تعالی گفت
اَوَلَمْ يَرَوْا اَنَّ اللّٰهَ الَّذِي خَلَقَهُمْ هُوَ
اَشَدُّ مِنْهُمْ قُوَّةً معني اولم یرو اینجا
اولم یعلموا است گفت ندانستید که
آن خدای که ایشانرا بیافرید از ایشان
قوي تر است پس هود علیه السلام
ایشانرا عذاب کرد ایدون گفت اَتَبْنُوْنَ
بِكُلِّ رِيْعٍ آيَةً تَعْبَثُوْنَ گفت بهرجا بنا
همي کنید وَتَتَّخِذُوْنَ مَصَانِعَ لَعَلَّكُمْ
تَخْلُدُوْنَ و کوشکها بنا همي کنید و
بمحکمی واستواری چنانکه درین جهان
جاودان مانید وَ اِذَا بَطَشْتُمْ بَطَشْتُمْ
جَبَّارِيْنَ چون کسی را خشم گیرید
چون جباران و خشم گرفتن جباران
آن بود که نه رحمت بود ونه بخشایش
ودست ازو باز ندارند تا اورا هلاك
نکنند فَاتَّقُوْا اللّٰهَ وَاَطِيْعُوْنِ از خدای
بترسید و مرا فرمان کنید پس نعمتهای

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تَخْلُدُوْنَ گفت بهر جای چیزی همي
بنا کنید چنانکه بازي کنید و کوشکها
همي بنا کنید محکم و استوار چون
کسی کی او بدین جهان جاویدان
خواهد ماند وَاِذَا بَطَشْتُمْ بَطَشْتُمْ جَبَّارِيْنَ
و چون کسی را بخشم بگیرید گرفتن
جباران گیرید بی رحمتي و بی بخشایشي
و دست ازو باز ندارید تا او را هلاك
نکنید فَاتَّقُوْا اللّٰهَ وَاَطِيْعُوْنِ از خدای
عزوجل بترسید و مرا فرمان کنید
پس نعمتهای خدای بریشان مي شمرد
قوله تعالی وَاتَّقُوا الَّذِي اَمَدَّكُمْ بِمَا
تَعْلَمُوْنَ اَمَدَّكُمْ بِاَنْعَامٍ وَبَنِيْنَ وَجَنَّاتٍ
وَعُيُوْنٍ اِنِّي اَخَافُ عَلَيْكُمْ عَذَابَ يَوْمٍ
عَظِيْمٍ گفت بپرهیزید از ان خدای
بزرگ کی شما را ازین جهان آن داد
کی شما دانید چهار پایان و فرزندان
داد و باغهای و چشمهای آب و بهر
ان چهار پایان یاد کرد کی مردمان
بیاباني را نعمت گوسپند و گاو و شتر
و مانند این بود و نکته انکه نخست
مال را یاد کرد پس فرزندان آنست
کی فرزند و بالست و بمال فرزندان

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خدای تعالی بر ایشان یاد کرد گفت
وَاتَّقُوا الَّذِي أَمَدَّكُمْ بِمَا تَعْلَمُونَ أَمَدَّكُمْ
بِأَنْعَامٍ وَبَنِينَ وَجَنَّاتٍ وَعُيُونٍ إِنِّي
أَخَافُ عَلَيْكُمْ عَذَابَ يَوْمٍ عَظِيمٍ گفتا
بترسید ازان خدای که شما را ان داد
برین جهان از چهار پایان و فرزندان
و بوستانها و چشمهای آب و از بهران
چهار پایانرا یاد کرد خواستهٔ ایشان
دربیابان چهارپای بود از گاو گوسفند
واشتر و این برایشان گرامي بود
وحکمت اندرین آنست که نخستین
چهارپای را یاد کرد و بازخواسته که
بر مرد درسبز از فرزند نه بیني که مردم
نخست کسب خواسته آرزو کند پس
فرزندان پس هود علیه السلام ایشانرا
پنجاه سال بخدای تعالی همي خواند
وموعظة کرد وپند داد شان ایشان
جواب دادند و گفتند سَوَاءٌ عَلَيْنَا أَوَ
عَظْتَ أَمْ لَمْ تَكُنْ مِنَ الْوَاعِظِينْ
گفتند خواهي پند بده و خواهي
مده و ما بتو نخواهم گردویدن
چنانکه خدا تعالی گفت حکایةً قَالُوا
يَا هُودُ مَا جِئْتَنَا بِبَيِّنَةٍ وَمَا نَحْنُ

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توان داشتن و گفتست الْمَالُ وَالْبَنُونَ
مال را پیش از فرزند یاد کرد ازانکه
مال بر خلق گرامي بود هود ایشانرا
پنجاه سال همي بخدای عز وجل مي
خواند و پند مي داد ویرا جواب دادند
سَوَاءٌ عَلَيْنَا أَوَعَظْتَ أَمْ لَمْ تَكُنْ مِنَ الْوَا
عِظِينَ گفتند خواهي پند ده وخواهي مده
همه یکیست کی بتو نخواهیم گرویدن
قوله تعالی قَالُوا يَا هُودُ مَا جِئْتَنَا بِبَيِّنَةٍ
وَمَا نَحْنُ بِتَارِكِي آلِهَتِنَا عَنْ قَوْلِكَ وَ
مَا نَحْنُ لَكَ بِمُؤْمِنِينَ گفتند ما را
همي گوئي کی این خدایان ما نه
خدایان اند و بدین حجت و درستي
نیاوردي و ما بگفتار تو این خدایانرا
دست بازنخواهم داشتن و بتو نخواهیم
گرویدن إِنْ نَقُولُ إِلَّا اعْتَرَاكَ بَعْضُ
آلِهَتِنَا بِسُوءٍ ما چندین دانیم کی تو
دیوانه شدهٔ و این خدا یان ما کی تو
ایشان را نمی پرستي ترا دیوانه کرده
اند بس هود پنجاه سال ایشانرا
مي خواند و کس بوی نگرویدند
و آنکه بگروید دین خویش پنهان
مي داشت و آشکارا نیارست کردن

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بدآرکی آلِهَتِنا و مَا نَحْنُ لَكَ بِمُؤْمِنِينَ
گفتند یا هود مارا میگوئي که این
خدایان ما نه خدایند و بدین حجتی
درستي نیاوردي و ما به گفتار تو
نخواهیم ازین خدایان دست باز
داشتن وبه تو گرویدن چنانکه خدای
تعالی گفت اِنْ نَقُولُ اِلَّا اعْتَرَاكَ بَعْض
آلِهَتِنَا بِسُوْءٍ ایدون گویم که تو دیوانه
شدي و این خدایان ما ترا دیوانه
کردند پس پنجاه سال ایشانرا بخدای
تعالی خواند هیچ نگرویدند و انچه
بگرویدند دین خویش پنهان مي
داشتند پس چون روزگار بسیار برآمد
و هود علیه السلام نومید شد ازیشان
خدای تعالی خواست که ایشانرا
عذاب کند آن چشمهای آب همه
خشك شد و چهار پایان همه بمردند
وسه سال باران نیامد و قحط بر ایشان
افتاد و آن مردمان که بزمین شام و
حجاز بودند هرگاه که باران باز ایستادی
به زمین مکه آمدندی و انجا قربان
کردندی وخدای تعالی را خوا ندندی
هرچند که کافران بودند وخانه را اثر

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چون روزگاری بسیار برآمد و هود
از ایشان نومید شد و خدای تعالی
دانست کمي کس از ایشان نگرود
وخواست که ایشانرا عذاب کند ان
چشمهای ایشان خشك شد و چهار
پایان شان همه بمردند وسه سال‌شان
از آسمان باران نیامد وقحط برایشان
افگند وهرکجا اززمین شام کی چون
باران شان نیامدی سوی مکه آمدندی
و آنجا قربان کردندی . و خدای
عزوجل را خواندندی هرچند کافر
بودندی وخانه را اثر بدید نبود کی
خانه ازوقت طوفان نوح ناپدید بود
تاوقت ابراهیم علیه‌السلام کی ابراهیم
آن براورد ولیکن کافر آن همه مي
دانستند کی این زمین مکه زمین
حرم است وشنیده بودند کی ایذا
خانه خدای آسمان است پیش
ازطوفان بخبرها اندران حرم را بزرگ
داشتندی و هرکرا حاجتی بودی
دانستی کی این حاجت جزخدای آسمان
روانتواند کردن و چون بیمار را
عافیت خواستندی وچون کسی را

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پدید نبود و از وقت طوفان تازمان
ابراهیم علیه السلام ناپدید بود پس
این کافران همي دانستند که این
زمین مکه زمین حرم است وشنیده
بودند که انجا خانهٔ بود پیش از
طوفان وآن حرم را بزرگ داشتندی
و جایگاه حرم تا انگاه بالای او بود چون
کوه پاره بر دیگر جایها بلند و برج
و هر کرا حاجتي بودی که دانستی
که آن حاجت را جز خدای تعالی
روا نکند چون باران و فرزندان و از
دشمن فرح و از دوست راحت
برسرآن کوه خدای را بخواندندی
پس خدای تعالی حاجتهاي شان روا
کردی وعلما و متکلمان ایدون گویند
که این از بهرآن بود که خدای تعالی
هرگز زمین بی حجت ندارد وخلق را
بغفلت اندرنه پسندید و بزمانه پیشین
از هود علیه السلام پیامبری نبود
که خلق را بخدای خواندی از حرم
راحت خویش کرد به زمین تا چون
این حاجتها شان همه روا شدی
و علامتها پدید آمدی بدانستندی

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اسیری بدست دشمن بودی وچون
ستمگار بودی کی با او خصم او بر
نیامدی بزمین مکه آمدندی و قربان
کردندی وبرسرآن کوه خدای عزوجل
را بخواندندی و این از بهر آن بود
کی خدای تعالی زمین را بی حجت
ندارد وخلق را در غفلت نگذارد
و دران زمانه پیامبر نبود کی خلق
را راه نمودی حرم را حجت خویش
کرد بزمین تا چون این حاجتها شان
روان شدی و این علامتها بدیدندی
بدانستندی کی ایشانرا خدای هست
نه این بتان کی این کارها او همي کند
آن حجت خدای عزوجل بود برخلق
تا هریك بخدا عزوجل نگررد او را
حجت نبود و نتواند گفتن کی من
نشناختم و ندانستم و نام خدای
تعالی نشنیدم بل کی حجت خدای
عزوجل را بود تا چون او را نپرستند
ایشانرا بدوزخ کند بحجت پس چون
کار برقوم عاد سخت شد گفتند مارسول
فرستیم بحرم و قربان فرستیم تا دعا
کند و مارا باران آید از آسمان یکی را

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که ایشانرا آفرید کاری هست و این
بتان چیزی نیست و چیزی نتوانند
کرد و این حاجتها خدای تعالی
روا کند نه بتان آن حجت خدای بود
بر ایشان تا هرکه بر خدای عزوجل
نگروید او را حجت نبود و نتواند گفتن
که من نشناختم خدایرا ندانستم چه
حجت برایشان بود و اگر خدای را
نه پرستند و بدوزخ برد شان پس
گفت چون کار سخت شد برقوم عاد
وصلیت ندانستند گفتند یا رسول
فرستیم تا دعا و قربان کند تا باران
آید ازآسمان وسه کس‌را اختیارکردند
از مهتران یکی‌را نام‌لقمان بن هذیل
و او از مهتران بود و به نسب بعاد
نزدیکتر بود و با هود علیه السلام
گرویده بود و از مردمان پنهان همي
داشتی و آن دیگر مردی بود نا مش
مرثد بن سعد او نیز بر دین هود
علیه السلام بود و بوی آشکارا گرویده
بود وهم از مهتران ایشان بود وسویم
را نام قیل بن عمر و بن مرثد آنکه
بادشاه بود و کافر بود و با هود

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فرستادند نام اولقمان و از ایشان
ببالا و بسال مهتر بود و بقوت و بعاد
بنسب نزدیکتر بود و لقمان بن لقیم
بن عاد بزرگ بود و در نهان با هود
پیغامبر یکی بود و مردی دیگر نام او
مرثد بود بن سعد و بردین هود بود
وبدو گرویده بود آشکارا و هم مهتر
ایشان بود و همدیگر مردی بود نام
اوقیل وکافر بود وبا هود بتعصب بود
ومتهر ایشان هرسه بود بس هرسه
تن را بفرستادند با چهار پایان بسیار
ازگوسپندان وگاو وشتر وگفتند این
چهارپایان را بمکه قربان کنید واز
خدای تعالی ما را باران خواهند
ومیان ایشان ومیان زمین مکه
سه‌روزه راه بود هود علیه‌السلام ایشانرا
گفت ای قوم بمن بگروید تا خدای
تعالی مارا باران‌دهد اگر باران خواهید
قوله تعالی اسْتَغْفِرُوا رَبَّكُمْ ثُمَّ تُوبُوا
إِلَيْهِ يُمَتِّعْكُمْ مَتَاعًا حَسَنًا وَيَزِدْكُمْ قُوَّةً
إِلَى قُوَّتِكُمْ بس سخن هود نشیدند
وآن مکانه را بفرستادند تا بزمین
مکه آمدند وایشانرا بمکه خویشاوندان

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علیه السلام بتعصب بود و مهتر
ایشان بودم سه تن را بفرستادند با
چهار پایان بسیار از گاو و گوسفند
و اشتر و ایشانرا گفتند بشوید بمکه
و این قربانهارا آنجا بکشید و از خدای
آسمان مارا باران خواهید میان
ایشان و مکه سه روزه راه بود و هود
علیه السلام ایشانرا گفت یا قوم بمن
بگروید تا خدای تعالی شمارا باران
دهد چنانکه گفت اَسْتَغْفِرُوا رَبَّكُمْ ثُمَّ
تُوبُوا اِلَيْهِ يُرْسِلِ السَّمَاءَ عَلَيْكُمْ مِدْرَارًا
وَيَزِدْكُمْ قُوَّةً اِلَى قُوَّتِكُمْ ایشان سخن
هود علیه السلام نشنیدند و این سه تن
را فرستادند و چون بیامدند به زمین
مکه ایشان را خویشان بودند هم از
قبیله عاد ازان گروه یکی معاویه
بن بکر بود ایشانرا فرود آوردند ومهمان
داشتند و دانستند که ایشان عاد اند
بیاران خواستن آمده اند گفتند
سه روز مهمان باشید و آنکه بکار
خویش مشغول شوید گرامي کردند
ایشانرا و نبیذ آوردند و کنیزکان
مغنیه و ایشان به بینند و مهماني

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بودند از کوه معویه بن بکر ایشانرا
مهمان داري کردند و گفتند کی سه روز
برما مهمان باشید وانگاه بکارما مشغول
شوید وخوانها شان نهادند نبیذ شان
دادند و کنیزکان مطرب آوردند وبمی
خوردن مشغول شدند یك ماه و از
قوم خویشتن شان یاد نیامد بعد از
یکماه این مهمان داران دانستند کی
ایشان بلهود نبیند قوم خویش را
فراموش کرده اند و غم همي خوردند
کی آن قوم عاد هم خویشان ایشان
بودند و شرم داشتند کی ایشانرا از
خانهٔ خویش بیرون کنند و باز کار
فرستند آن کنیزکان مطرب را شعر
آموختند تا آنرا بلحن و سرود پیش
ایشان بگفتند دران یاد قوم و آنچ
بر ایشان می رود از تشنگي چون آن
قوم از مطربان حدیث قوم خویش
شنیدند از قوم خویش یاد آمد وگفتند
کی ما خطا کردیم کی قوم خویش را
فراموش کردیم برخاستند کی قربانها
ببرند این مرثد و لقمان کی بهود
گرویده بودند دین خویش را پیدا کردند

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خوردن مشغول شدند یکماه آنجا
بماندند وامروز بعرب اندر مثل زنند
هرجا که رسولی فرستند بکاری وآن
بکار خویش مشغول شود و اورا فرستد
یاد نکند او را وفد عاد گویند پس
چون یکماه ببودند میزبان دانست
که ایشانرا قوم خویش فراموش گشت
قوم عاد خویشاندان او بودند شرم
داشت که ایشان را از خانهٔ خویش
بیرون ونا کاری فرستد که آمده اند
مرآن کنیزکان را که مغنیه بودند بیتی
چند شعر بگفت وآن کنیزکان را
بیاموخت تا درسرود بگفتند * شعر *
ایا قیل و یحك قم فهم لعل الله
سحبا سحابا * فیبقي ارض علینا
سحا فقد صارت دیارکم خرابا * فانت
عاد قومك یا بن عمرو عیب مذاک
لدکت اسکابا * فما هذا التهاون عن
مقام یرجي فیه قومك ان نجانا *
پس چون ایشان این بیتها بگفتند
بوی اندر حدیث عاد گروه وآن سختي
و تشنگي که بر ایشان بود چون این
بشنیدند ایشانرا یاد آمد آنکه با

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و مرقیل را گفتند این یکی را که کافر
بود اگر قوم ما بهود بگرویدندی خود
ایشانرا باران آمدی و این قربانها
نبایستی قیل دانست کی ایشان بهود
گرویده بودند واز هلاک قوم پاک ندارند
ایشانرا بگذاشت و خود تنها برفت
و برسر کوه برشد کی جای قربانست
بکوه مني وآن قربانها بکشت وسر
سوی آسمان کرد و گفت ای خدای
آسمان تو داني کی من اینجا بحاجت
آمدم وحاجت من نه بیماریست کی
ورا شفاخواهم ونه اسیری کی راحتش
خواهم ولیکن باران خواهم قوم
خویش را کز تشنگي هلاک شدندی
و میگفت و دعا همیکرد تا سه ابر
بر آمد و بهوا بایستاد یکی سپید ویکی
سرخ ویکی سیاه وآوازی ازهوا برآمد
کی ازین سه ابر کدام خواهي بگزین
تا بقوم تو شوند با خود گفت کی این
سپید دانم کی تهیست درو باران نبود
واین سرخ ندانم کی بمیان اوچه بود
وابر سیاه میان او باران بود کی مارا
چون ابر سیاه آمدی ازو باران آمدی

Text of Tabary.

خویشتن بگفتند که ما خطا کردیم
قوم خویش را فراموش کردیم
برخواستند که قربانها ببرند لقمان
و مرثد که با هود علیه السلام گرویده
بودند دین خویش را پیدا کردند و قیل
را گفتند که اگر قوم ما بهود علیه السلام
بگرویدندي ایشانرا باران آمدی
و این قربانها نبایستی و رنج آمدن
هم نبودی قیل چون این حدیث
از یشان بشنید خشم گرفت برایشان
مرثد ولقمان از پیش او برفتند تا
بکعبه فراز رسیدند مرثد دست بر
آسمان برداشت و گفت * شعر *
یارب یارب الجود و الماجدالفرو العلي
الواحد * ان ابن عمرو قد اتاك طالبا
مستعمیا * ملك الیك داعیا بین
معشر * فرد حجاز هم بارزاق العباد *
تفسیر این بیتها بفارسي گوید ای
خدای دهنده و بزرگوار پسر عمرو از
برای تو آمد باران خواهنده ازبرای
قوم کافر حاجت او روا کن ای روزي
دهندهٔ بندگان پس چون او بگفت
لقمان برخاست و گفت بدعا * شعر *

Text of Ghazzály

بانگ کرد کی این ابر سیاه خواهم
کي بقوم من شود و دران ابر سیاه
باد غدار بود خدای عز و جل فرشتگان
عذاب را فرمود تا آن ابرسیاه را بزمین
قوم عاد راندند وقیل از کوه فرود آمد
و سوی آن دوبارخویش رفت و گفت
کی ابر سیاه بر آمد: با باران و بقوم
خویش فرستادم و با ایشان بشراب
نشست و آن ابر بقوم عاد رفت و بیش
ابر باد همي شد چون ابر سیاه نزدیك
ایشان رسید شادي کردند کی باد و
ابر برآمد و باد ان قوله تعالی فَلَمَّا
رَأَوْهُ عَارِضًا مُسْتَقْبِلَ اَوْدِیَتِهِمْ قَالُوا هَذَا
عَارِضٌ مُمْطِرُنَا و هود می دانست کی
آن عذابست کی او را خدای تعالی
آگاه کرده بود ایشانرا گفت بَلْ هُوَ مَا
اسْتَعْجَلْتُمْ بِهِ رِیحٌ فِیهَا عَذَابٌ اَلِیمٌ پس
چون برابر سر ایشان رسید با یستاد
و آن باد عقیم از وبیرون آمد چنانکه
خدای عز و جل گفت وَفِي عَادٍ اِذْ
اَرْسَلْنَا عَلَیْهِمُ الرِّیحَ الْعَقِیمَ و عقیم
آن بودکی ازو هیچ منفعت نبود و از
باد بدین جهان اندر منفعتهای بسیار

Text of Tabary.

يارب اني قدمن مصدق * و انت ربي
يهدي موفق * فمن يارب علي منّا *
ان يحبس القطر ولانصا * بپارسي
چنين گويد كه اى خداى راست گو
راه راست دهندهٔ من مومنيم و گفتار
تو خداى راست دارم منت كن برمن
كه باران باز داري و ندهي پس بانگ
آمد كه دعاى شما نزديك خداى
تعالى مستجاب شد پس ايشان بگذاره
شدند و بخواستند كه بادشاه ايشان
بداند كه پيش ازو بدعا آمدند بخلاف
آنكه او همي خواهد چون يكزمان
بود بادشاه آمد كه نام او قيل بود و
كافر بود تنها برفت برسر كوه برشد
آنجا كه جاى قربانست بكوه مناوان
قربانها بكرد و باز آمد تا به كعبه
پس گفت * شعر * يارب قد جيت
مستعميا فقد منذا بالذي و هيذا * من
شدم الاقحاط والثغوب فنالنا فى الناس
من حزبت فيما يلسا * عند امساک
المطر من الشد الحال مما ان مقرلا
اليک فاستغمذا * الغياث حتى يعجم
الحزن والدمانا * بپارسي چنين گويد

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است كى درختانرا آب بريزد و ميوها
بگيرد وكشتيهارا بدريا براند و بويهاى
خوش بيارد و اب سردكند و برىادي
كى اندروازين معني چيزى نبود آنرا
عقيم خوانند وجاى ديگرعاتي خوانند
قوله تعالى وَأَمَّا عَادٌ فَأُهْلِكُوا بِرِيحٍ
صَرْصَرٍ عَاتِيَةٍ وصرصر باد سرد بود
و عاتيه بى فرمان آنكه كس او را از
خويش نگاه نتواند داشتن بس هرج
ايشانرا چهار پاى بود باد از زمين
بر گرفت و بر هوا برد و بر زمين زد
و پاره پاره بكرد قوله تعالى مَا تَذَرُ مِنْ
شَيْءٍ أَتَتْ عَلَيْهِ إِلَّا جَعَلَتْهُ كَالرَّمِيمِ
و رميم آن استخوانها بود كى برو سالها
گذشته باشد و باران بسيار برو برگذرد
چون بدست مالى همه خاك شود
پس چون ايشان آن هول بديدند
گفتند صبر كنيد كى از بس باد باران
بود از خانها بيرون آمدند و برسادهٔ
زمين پاى فرو بردند تا ساق و بيستادند
بمردى و هود پنداشت كى بسوى
او آيند و خواهش خواهند و بخداى
عزوجل بگروند نگرويدند و باد اندرآمد

Text of Tabary.

که یاخدای ما باتو آمدیم باران خواهم
که مبتلا گشتیم باآنچه بما رسید از قحط
وکم بودن چهارپای واشتر و بهیچ
کس نتوانیدم گریختن الا مارا تو بارانی
ارزاني دار و مرا و هامون را ترکن و
مارا سیراب کن و سر بآسمان کرد و
گفت یا خدای تو داني که من بحاجت
آمده ام حاجت من نه بیماریست که
عافیت خواهم ونه اسیریست که راحت
خواهم ولیکن باران خواهم مر قوم
خویش را که از گرسنگي هلاک شدند
وهمي دعا کرد تا سه ابر آمد وبهوا
اندرایستاد یکی سپید ویکی سرخ ویکی
سیاه واورا از هوا بانگ آمد که ازین
سه ابر کدام خواهي بگزین تا بقوم تو
شود او بخویشتن اندیشه کرد وگفت که
این ابر سپید دانم که تهي بود وبمیان او
باران نه بود واین ابر سرخ ندانم
بمیانش چه بود ولیکن ابر سیاه را
باران بود که مارا چون باران آمدی
ابرسیاه آمدی ابرسیاه را بگزید وبانگ
کرد که این ابرسیاه خواهم که بقوم من
شرد و بدان ابرسیاه اندرباد عذاب بود

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وهریکی را از زمین برگرفت و بهوا
بر یزد و بزمین برزد وبکشت تا همه
را بکشت وهریکی را چند درختی
برزمین افگند قوله تعالی كَأَنَّهُمْ أَعْجَازُ
نَخْلٍ خَاوِيَةٍ گفت چون درختان خرما
کز زمین برکني و بفگني والخاوية
الساقطة علی الارض خوی النجم اذا
سقط قوله تعالی كَأَنَّهُمْ أَعْجَازُ نَخْلٍ
مُنْقَعِرٍ و هرکه از یشان بگریخت باد
از بس او بشد و اورا نیز برزمین
زد وبکشت و زنانرا نیز بخانها اندر
شد و ایشانرا از زمین بر می گرفت
وازین دیوار بدان دیوار می زد تا همه
را بکشت هفت شبانروز آن بادرا
بریشان مسلط کرد قوله تعالی سَخَّرَهَا
عَلَيْهِمْ سَبْعَ لَيَالٍ وَثَمَانِيَةَ أَيَّامٍ حُسُومًا
یعني دایمه وهیچ کس از یشان نماند
مگر هود پیغامبر علیه السلام و آنکه
مومن شده بودند باد ایشانرا هیچ زیان
نکرد قوله تعالی فَلَمَّا جَاءَ أَمْرُنَا نَجَّيْنَا
هُودًا وَالَّذِينَ آمَنُوا مَعَهُ بِرَحْمَةٍ مِنَّا
وَنَجَّيْنَاهُمْ مِنْ عَذَابٍ غَلِيظٍ واین
وفدایشان بمکه نشسته بودند هرسه

Text of Tabary.

خدای تعالی فرشتگان عذاب را فرمود
تا ابر سیاه را براندند و بزمین قوم
عاد بردند و قیل از کوه فرود آمد
بسوی یاران خویش و ایشانرا گفت
ابر سیاه پر باران فرستادم بسوی قوم
و بایشان بمی خوردن بنشست و این
ابر برفت بقوم عاد و باد پیش او همي شد
چون ابر نزدیک ایشان برسید شادي
کردند و گفتند باد آمد و ابر برآمد
وباران آمد چنانکه خدای تعالی گفت
فَلَمَّا رَأَوْهُ عَارِضًا مُسْتَقْبِلَ أَوْدِيَتِهِمْ قَالُوا
هَذَا عَارِضٌ مُمْطِرُنَا و هود علیه السلام
دانست که آن عذاب است که خدای
تعالی اورا آگاه کرده بود و ایشانرا گفت
بَلْ هُوَ مَا اسْتَعْجَلْتُمْ بِهِ رِيحٌ فِيهَا عَذَابٌ
أَلِيمٌ چون ابر بر ایشان رسید بایستاد
و آن باد عظیم ازان جا بیرون آمد
چنانکه گفت وَفِي عَادٍ إِذْ أَرْسَلْنَا
عَلَيْهِمُ الرِّيحَ الْعَقِيمَ و عقیم آن بود که
ازو هیچ نفع نبود و از بادها بدین
جهان منفعتها است که درختان را
آب بر یزد و میوه ها بگیرد و کشتي‌ها
بدریا اندر براند و بویهای خوش بیارد

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و همي خوردند و خبر نداشتند
تا مردی آمد بر شتری نشسته نه از قوم
عاد ولیکن بوادي عاد برگذشته بود
وآن بدیده بود ایشانرا خبر داد کی
همه خلق هلاک شدند مگر هود وانکه
بدو گرویده بودند این دو تن مومن
شاد گشتند و قیل کافر از بهر قوم
خویش اندوهگین شد برخاست و بر
کوه مني برشد واین لقمان و مرثد
با او برشدند و اورا گفتند بهود بگرو
والا تو نیز هلاک شوي هم چنانکه
قوم عاد شدند او گفت مرا بس ایشان
زندگاني نیابد وسر درکرد وگفت ای
خدای آسمان اگر این سخن راست است
وقوم من هلاک شدند مرا نیز هلاک کن
بادی برآمد و ویرا ازسر کوه برگرفت
وبر زمین زد وبکشت واین دوتن کی هود
ایمان آورده بودند ایشانرا ازکوه آواز
آمد کی شما هرکسی چیزی بگزیند
خویشتن را تا بیابید مرثد بن سعد
گفت خواهم کی مرا گندم بود چنداني
کی تا زنده باشم نان گندمین خورم
اورا اجابت آمد برفت وبه مکه آمد

Text of Tabary.

و هر بادی که اندر وی منفعتها بود
اورا عقیم نگویند و عاتیه وصرصر که
باد های عذاب است و بر سر ایشان
بایستاد و هرچه ایشانرا چهار پای بود
از زمین برگرفت و بهوا برد و پاره پاره
کرد چنانکه خدای تعالی گفت مَا تَذَرُ
مِنْ شَيٍّ اَتَتْ عَلَيْهِ اِلَّا جَعَلَتْهُ كَالرَّمِيْمِ
ورمیم آن استخوانها بود که سالهای
بسیار برو برآید و سست وفرسوده شود
واگر بدست بمالي خاک شود و گفت
هر چیزی که آن باد بدو آمدی
چون خاك گردانیدی پس چون
ایشان هول آن باد بدیدند هریك
با دیگر گفتند صبر کنید که از پس
این باران بود پس از خانا ها بیرون
آمدند بر ساده زمین و پای بر زمین
فرو بردند تا ساق و با یستادند و هود
علیه السلام ایدون پنداشت که سوي
وبزنهار آیند وخواهش کنند وبخدای
عز و جل بگروند ازین قوم هیچ
نگرویدند چون آفتاب فرو شد بادی
برخاست عظیم از میان دوکوه بزرگ
و هر زمان که برامد سخت تر بود

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ازان کوهوانجا بنشست تابمرد ولقمان
گفت من عمر خواهم بسیار اورا آواز
آمد کی هرچند دیرتر زيي آخر هم
ببايد مرد گفت روا است گفت ترا باد
عمر هفت کرگس و نیز هم بمکه
بنشست و برسر کوه برشدی انجا
کی کرگس خابه کند و بچهٔ کرگس را
نگاه داشتیچون ازخابه بیرون آمدی
برگرفتی وبپروردی تا هفت کرگس
بپرورد باز بسین کرگسان لُبد نام بود
پس لقمان با لُبد هردو بیکجای
بمردند محمد جریر گفت کی هرگز
کسی هشتاد سال نزیست وبجزهای
دیگر بیشتر گفتند کی بزیستي و هود
با آن مومنان بزمین عاد بماندند
از بس عاد پنجاه سال بس بمرد وعمر
او صد و پنجاه سال بود ونیز ازبس
هود صد سال دیگر تا قوم صالح
وثمود واندران صد سال هیچ پیغامبر
نبود همه ملوک بودند و هریکی را
دینی جدا بود یکی بت پرست
و یکی آتش پرست و هرگونه تا وقت
صالح علیه السلام *

Text of Tabary.

پس زنی از یشان که او را بهدوانی خواندندی بمیان میغ اندر نگریست تف آتش دیدند که زمانه همي زد آن زن بترسید و دست بر دست زد و اینکه اکنون کسی را محنتی رسد دست بردست زند ازان وقت باز ماند پس آن زن بانگ زد تا همه بزرگان نزدیك او آمدند و آن زن گفت * شعر * ان الذي فطر السماء نارا * انبشر من حرفها اثرزارها * فاستخروا بالرسول هود * نبي الرب الواحد المعبود * فقد آناکم عنفیر و ایته * ولیس یبقي فیکم من باقیة * پارسي گوید ای مردمان من بمیان آسمان آتشی همي بینم درخشند زد و باشید ودست بهود پیامبر زنید که شمارا عذابی همي آید وکاری بزرگ همه بدان هلاك شوند و هیچ کس نمانید هیچ کس بگفتاري او گوش نکردند وباد هریکي را بگرفت و بر هوا برد و بر زمین زد وبکشت و هریک ازیشان چون خرما بنان بدرازي افتاده بودند چنانکه مرده صد ساله وخدای تعالی گفت كَأَنَّهُمْ اعْجَازُ نَخْلٍ مُنْقَعِرٌ گفت چون بودند که درخت خرما را برکني وبیفگني تا آنهمه را اینچنین قد بود و هریك چون خرما بني افتاده و چنین گویند بدان هنگام که باد یک یک را بر زمین زدی درمیان ایشان یکی بود نام او خلجان بگریخت و بکوهی برشد و از دور همي دید که برباران او چه می رسد بازفراز آمد ازسرکوه وبنزدیك هود علیه السلام آمد هود علیه السلام گفت یا خلجان مسلمان شو تا برهي گفت یا هود مرا خدای تو چه دهد اگر مسلمان شوم هود علیه السلام گفت ترا بهشت دهد پس آنکه خلجان گفت چه بود که میان ابر چون اشتران بختي است هود علیه السلام گفت آن فرشتگانند خلجان گفت اگر من مسلمان شوم خدای تعالی مرا ایشان گرداند هود علیه السلام گفت آدمي را فرشته نگرداند گفت پس مسلمان نشوم همان ساعت بادی بیامد وبر هوا برد و به زمین زد

Text of Tabary.

وبکشت وانها که به خانها شدند ودرها بستند باد بخانها اندر شد و ایشانرا
از زمین برگرفت و بردیوار همي زد تا می مردند واین باد هفت شبانه
روز برایشان مسلط بود چنانکه خدای تعالی گفت كَذَّبَتْ ثَمُودُ وَعَادٌ بِالْقَارِعَةِ
فَأَمَّا ثَمُودُ فَأُهْلِكُوا بِرِيحٍ صَرْصَرٍ عَاتِيَةٍ سَخَّرَهَا عَلَيْهِمْ سَبْعَ لَيَالٍ وَثَمَانِيَةَ أَيَّامٍ
حُسُومًا فَتَرَى الْقَوْمَ فِيهَا صَرْعَى كَأَنَّهُمْ أَعْجَازُ نَخْلٍ خَاوِيَةٍ فَهَلْ تَرَى لَهُمْ
مِنْ بَاقِيَةٍ حسوما گفت یعنی دایمه وگفت عزوجل فَهَلْ تَرَى لَهُمْ مِنْ بَاقِيَةٍ
بیني که از ایشان کسی نماند مگر هود پیغامبر علیه السلام وانکسانی که
مومن بودند وبهود علیه السلام گرویده ایشانرا باد هیچ زیادتي نکرد چنانچه
گفت جل جلاله فَلَمَّا جَاءَ أَمْرُنَا نَجَّيْنَا هُودًا وَالَّذِينَ آمَنُوا مَعَهُ بِرَحْمَةٍ
مِنَّا وَنَجَّيْنَاهُمْ مِنْ عَذَابٍ غَلِيظٍ و این وقت ایشان بمکه نشسته بودند
وهرسه می میخوردند واگاهی نداشتند تا یکی مردی همي آمد براشتری
نشسته نه ازان قوم ولیکن بوادي عاد برگذشته بود با ایشان خبر آمد که
همه هلاک شدند مگر هود علیه السلام بدو گرویده بود پس آن دوتن که
مومن بودند لقمان ومرثد بمکه شادي کردند وسپاس داري مرخدای
را عزوجل کردند وآن دیگر که قیل بود دژم وغمگین نشسته بود از بهر
قوم خویش آن دوتن مومن گفتند که برسرکوه میدنا بودند پیش قیل
آمدند وگفتند یا قیل از نسل عاد زندگاني نیابي قیل گفت یا خدای
آسمان اگر این سخن راست است وقوم من هلاک شد تو نیز مرا هلاک
کن پس همچنان بادی بیامد واورا ازسرکوه درربود و برزمین زد و
کشت لقمان و مرثد شکر خدای کردند عزوجل پس هود علیه السلام
ایشانرا آواز داد ازانجا که بود و خدای تعالی آواز هود علیه السلام
بایشان رسانید وگفت شما هرکسی چیزی را بگزینید تا خدای تعالی
شما را بدهد مرثد گفت خواهم مرا گندم چنانکه تا باخر عمرمرا بس

3 Q 2

Text of Tabary.

بود اجابت شد و بمکه رفت و انجا بود تا بمرد و لقمان گفت من درازي
عمر میخواهم پس گفت اگرچند دیر بماني عاقبت بمیري گفت روا است
پس خدای تعالی اورا زندگاني داد چندانکه هفت پادشاه پادشاهي کردند
و بمردند و چنین گویند که کرگس را زندگاني دراز بود پس این لقمان
بچه کرگس را بگرفتی و بداشتی پس کرگس آخررا که داشت نامش لبد
برنهاد و هفتصد سال بزیست آن کرگس پس عرب گفتی بمثل که طَالَ
الْاَمَدُ عَلَی لُبَدٍ پارسي چنین گوید که دراز شد مدتی زندگاني بر لبد و این
لفظ مثل شد در عرب پس لقمان ولبد در یکروز بمردند و هود علیه
السلام با مومنان اندر زمین عاد ببودند و از پس قوم عاد پنجاه سال دیگر
بزیست و عمر هود علیه السلام صد و پنجاه سال بود تا وقت صالح علیه السلام
وقوم ثمود همه ملکان بودند هرکسی بدیني جدا جدا آتش پرست
و بت پرست و آفتاب پرست و هرگونه دینها بود تا وقت صالح علیه السلام *

What follows is not found in Ghazzály.

و ابن عباس رضي الله عنه چنین گفت که ایزد تعالی باد صرصر را
بمقدار فراخي انگشتري فرستاد که قوم عاد را هلاك کردند و اگر فزون تر
بودی همه خلق هلاك شدی و دغفل چنین گوید یا علي بن ابیطالب
رضي الله عنه نشسته بودم که پیری کهن سالي فراز آمد و بپرسید که
امیرالمومنین کدام است گفتم اینکه روی را بعلي رضي الله عنه کرد و گفت *
اسمع بکلامي هداک الله من هداک فا فرح بعملك عن علت صادي * سمعت
بالدین دین الحق یا بمحمد و هو بني الحضر و البادي * فدک علی القصد
و علی الترتیب من خلدی بشرعة ذات ایضاحتی و ارشاد * ان الهدایة بالایمان
ناجیة عن العمر و النقي من خیل الراد * پارسي این بیتها چنین گوید که
ای راه نمای راست بشنو و دلیل باش برحق تا شك از دل من بزولي که

دين محمد صلی الله علیه وسلم حق است و بهترین دینها است امیرالمومنین علي رضي الله عنه عجب ماند از شعر و فصاحت او پس گفت از کجائي گفت از حضرموت پیش تو رغبت کردم تا مسلماني بیاموزي علي رضي الله عنه گفت ترا خدای تعالی توفیق دهاد هرچه تو ازو خواهي از من بیابي پس او را گفت دانش تو چگونه است بدین کارها باحقاف. رسیدی مرد گفت از گور هود علیه السلام خواهي علي رضي الله عنه گفت که بیان کن آن مرد گفت که من بوقت برنائي با گروهی از اهل بیت خویش بگور هود علیه اسلام رسیدم اشکاق دری با یست شدن سخت تنگ درمیان کوه برکونهٔ سروآبه مطبق بدو سنگ بزرگ انجا یکی خانه چهار سو کنده بود و چهل ارش بدان خانه اندر یکی تخت نهاده از رخام دراز و فراخ هود علیه السلام را بر انجا خوابانیده دست بدو فراز کرد تازه ایستاده بود بر مثال زنده و بر سر آن لوح نهاده بود از رخام و انجا نوشته بود که بِاسْمِكَ اللّٰهُ الْعَلِيَّ وَ اَنَا هُوْدَ النَّبِيِّ رَسُوْلُ رَبِّ الْعِبَادِ اِلَى الْمَلَاءِ عَادِ فَدَعَوْتُهُمْ اِلَى الْاِيْمَانِ وَ خَلَعَ الْاَنْدَادِ وَ الْاَوْثَانِ هَلَكُوْا بِرِيْحِ الْعَقِيْمِ فَاَصْبَحُوْا كَالرَّمِيْمِ بپارسي چنین است که بنام خدای بزرگوار من هود پیامبرم بقوم عاد وایشان را با یمان خواندم تا ازبت پرستیدن باز دارم فرمان من نبردند همه بباد عقیم هلاک شدند علي رضي الله عنه گفت صداقت راست همي گوئي و فرمود تا او را سورهٔ چند از قران بیاموزند و بسیار هدیه داد چندین گوید دغفل که چون قوم عاد را هلاک برآمد بزمین یمن مرا کسان بودند که بهود علیه السلام بگرویده بودند که بحضر موت بودند چون یعرب بن قحطان بن عابر بن شالخ بن ارفخشد بن سام بن نوح علیه السلام برادران خویش را گرد کرد و همه از یك مادر بودند مادر شان از قوم عاد بود بدان سبب همه تازي بودند و مهترین ایشان یعرب بود پس جرهم و لقمان و ملتمس و عاصم و قطای و عاصیب همه بدست گرفتند و پیشین همه یعرب بود پس قحطان که انجا رسید همي بود *

PROCEEDINGS

OF THE

ASIATIC SOCIETY OF BENGAL,

For September, 1848.

The usual monthly meeting of the Asiatic Society was held at the Society's house on Wednesday evening, 6th September.

The Hon. J. W. Colvile, *President*, in the Chair.

The proceedings of the last meeting were read.

The accounts and vouchers for August were submitted.

Baboo Gobindchundra Sen and C. Thornhill, Esq. having been duly proposed and seconded at the August meeting, were ballotted for and elected members of the Society.

The following gentlemen were named as Candidates for election to be ballotted for at the October meeting.

Capt. Pakenham, Body Guard, *Capt. Powel*, Ship "Precursor," proposed by Mr. Frith, seconded by Mr. Laidlay.

Capt. Banks, proposed by W. Taylor, Esq. seconded by G. A. Bushby, Esq.

Lieut. F. W. Stubbs, Artillery, proposed by Lieut. Staples, seconded by Mr. Laidlay.

Read letters—

From G. A. Bushby, Esq. Secy. to Govt. of India, Home Dept. regarding the past and future application of the grant for Oriental Publications.

Home Department.—No. 685.

From G. A. Bushby, Esq., *Secretary to the Government of India,*
To W. B. O'Shaughnessy, Esq. Secretary to the Asiatic Society, dated the 29*th July,* 1848.

Sir,—With reference to my letters Nos. 240 and 247, dated 24th April 1847, I am directed by the Governor General in Council to inform the Asiatic Society that the Hon'ble the Court of Directors, in a Dispatch recently received, have authorized the grant to the Society of the privilege of drawing upon the Company's Dispensary for monthly supplies of spirits of wine not exceeding ten Gallons, on the understanding that a part of it will be applied in preparing specimens of Natural History for transmission to the Museum at the East India House.

2. The Hon'ble the Court of Directors have also sanctioned the remission of the demand to which the Society has become liable by the misapplication of the Government grant of 500 Rs. per. mensem for the publication of Standard Oriental works; and have authorized the continuance of the allowance, on condition that it be scrupulously applied to the collection and publication of Oriental works of interest and utility, an annual account being furnished to the Government of the appropriation of the sums received. I am accordingly directed to request that such accounts may be regularly furnished in future, and that a Statement be submitted of the appropriation of the sums received by the Society since April 1847, when the misapplication of the allowance was brought to notice.

3. With reference to the employment of this grant in the publication of the Vedas, you will be pleased to inform the Society that the Hon'ble Court have sanctioned the printing of the Rik Veda in England. It will therefore not be necessary to undertake the publication of that work in Calcutta. There are, however, other Vedas or portions of them which it is desirable to preserve through the means of the press, and which may very properly become the objects of the Society's attention.

I have the honor to be, Sir,
Your most obedient Servant,
G. A. Bushby,
Secretary to the Government of India.

Council Chamber,
The 29*th July,* 1848.

From W. Seton Karr, Esq. Under Secy. to Govt. of Bengal, forwarding a communication from Mr. Robinson, on the languages spoken by the Tribes inhabiting the valley of Asam and its confines.

Referred to the Oriental Section.

From H. M. Elliot, Esq. Secy. to Govt. of India, Foreign Dept. forwarding a narrative by Capt. Reynolds of our former relations with the Densarie Garrows.

From Capt. Thuillier, Officiating Deputy Surveyor General, forwarding Meteorological Register for August.

Communications were received and presented;—

From Dr. Aloys Sprenger, through H. M. Elliot, Esq. a Notice on Tabary and on an Historical work of Ghazzály.

From Prince Gholam Mohamed, presenting 2 copies of a Persian work, and 2 of English Memoirs of his grandfather and father, Hyder Ali Khan and Tippoo Sultan.

From H. Cuming, Esq. acknowledging the receipt of a bill of exchange for £25 10*s*. and requesting to know whether he is to continue to forward the Conchological Works of which portions had been sent to the Society. (To be referred to the Section of Natural History.)

From M. Eugene Burnouf, dated Paris, 10th January, regarding the edition of the Vedas now publishing by the Society.

From Lieut R. Maclagan, Principal of the Poostu College, forwarding some fragments of the History of Moultan.

From Messrs. Allen & Co. announcing shipment of the stock of copies of the Researches—also volumes of the Mahabharat and Mega. The expense amounting to £31 7*s*.

From Lieut. J. Strachey, forwarding two papers to be printed with his brother's Journal on the height of places in his route and on the construction of the map.

On the disposal of the business of the evening, Mr. H. M Elliot, V. P. after adverting to the heavy loss the Society had sustained by the death of Brigadier Stacy, so eminently distinguished for his antiquarian zeal, proposed the following resolution which was seconded by Mr. Laidlay, and carried unanimously.

"That the Society testify their respect for the memory of Brigadier Stacy, C. B., one of their most distinguished and liberal contributors, by entering upon record, their regret at the loss they have experienced by his death; and that this resolution be communicated by the Secretary to the surviving members of his family."

Meteorological Register kept at the Surveyor General's Office, Calcutta, for the Month of Oct., 1848.

Lat. 22° 33′ 28″. 33 N. Long. 88° 23′ 42″. 84 East. Mag. Variation 2° 28′ 36″ East. Mag. Dip. 27° 45′.

Days of the Month.	Observations made at sunrise. Barometer reduced to 32° Fahrenheit.	Temperature. Of the Mercury.	Temperature. Of the Air.	Temperature. Of Wet Bulb.	Wind. Direction at sunrise.	Aspect of the Sky.	Maximum Pressure observed at 9h. 50m. Barometer reduced to 32° Fahrenheit.	Temperature. Of the Mercury.	Temperature. Of the Air.	Temperature. Of Wet Bulb.	Wind. Direction at 9h. 50m.	Aspect of the Sky.
1S												
2												
3												
4												
5												
6												
7												
8S												
9												
10												
11												
12												
13	Inches	°					Inches	°				
14	29.695	76.2	77.3	76.4	E.	Rainy.	29.731	79.3	79.4	78.3	E. N. E	Rainy.
15S	.642	81.1	81.7	78.7	S.	Ditto.	.717	77.0	78.9	76.9	S.	Cloudy.
16	.817	75.3	75.9	72.0	S. W.	Cirro cumuli.	.868	82.0	81.5	76.3	W.S.W.	Cumuli.
17	.876	75.9	76.5	75.7	S. W.	Ditto.	.898	81.6	83.0	78 9	W.N.W.	Cumulo strati.
18	.844	77.9	78.8	77.9	S. W.	Cumuli.	.876	85 7	84.3	77.6	W. S.W.	Clear.
19	.862	74 2	75.3	74.3	N.N.W.	Clear.	.919	86.1	84.7	76.5	N.N. W.	Cumuli.
20	.906	75.8	75.3	74.0	N.	Ditto.	.971	86.1	85.3	75.8	N. E.	Clear.
21	.933	74.1	74.9	73.5	N.	Ditto.	.964	84.8	84.0	76.6	W.N.W.	Cumuli.
22S	.906	71.8	75.6	74.7	N.N.W.	Ditto.	.950	86.0	85.3	76.4	N. W.	Cumulo strati.
23	.902	75.0	76.2	74.8	S. W.	Ditto.	.961	85.3	84.3	76.3	W.	Ditto
24	.928	75.3	76.3	75.0	N.	Ditto.	.969	85.6	84.7	78.0	N.	Cumuli.
25	.971	74.4	75.3	74.4	W.N.W.	Ditto.	30.019	85 0	83.8	75.9	N. W.	Ditto.
26	.990	73 8	74.8	73.8	Calm.	Ditto.	.033	85.6	84.6	76.2	N.	Ditto.
27	.967	72.7	73.9	72.5	W.N.W.	Cirri.	.007	84.3	83.6	74.8	W.N.W.	Cirri.
28	.937	72.8	73.8	72.7	W. S.W.	Clear.	29.989	84.3	83.4	75.6	W.S.W.	Cirro cumuli.
29S	.955	75.4	76.6	75.0	S. S. W.	Cirro cumuli.	30.001	86.0	84.9	76.4	S. W.	Cumulo strati.
30	.960	75.4	76.7	75.8	S. S. W.	Clear.	.002	85 2	84.3	77.4	S. W.	Cumuli.
31	.970	75.2	75.7	74.3	W.	Ditto.	.016	84.6	84.2	77.9	W.N.W.	Clear.
Mean	29.892	75.3	76.1	74.8			29.938	84.3	83.6	76.8		
Mean of the Corresponding month of last year.	29.869	75.2	76.0	74.9			29.920	8.43	83.9	78.6		

Days of the Month.	Observations made at apparent noon. Barometer reduced to 32° Fahrenheit.	Temperature. Of the Mercury.	Temperature. Of the Air.	Temperature. Of Wet Bulb.	Wind. Direction at noon.	Aspect of the Sky.	Observations made at 2h. 40m. p. m. Barometer reduced to 32° Fahrenheit.	Temperature. Of the Mercury.	Temperature. Of the Air.	Temperature. Of Wet Bulb.	Wind. Direction at 2h. 40m. p. m.	Aspect of the Sky.
1S												
2												
3												
4												
5												
6												
7												
8S												
9												
10												
11												
12												
13	Inches	°					Inch.	°				
14	29.700	82.8	82.6	80.1	E.	Cloudy.	29.632	84.7	83.0	79.2	S.E.Shp.	Cloudy.
15S	.688	78.7	79.2	77.3	S. S. W.	Ditto.	.648	83.3	83.7	78.8	S. W.	Ditto.
16	.840	84.0	83.2	75.8	W.N.W.	Cumuli.	.798	86.0	84.8	77.3	W. S.W.	Ditto.
17	.865	88.4	87.2	80.2	W.S. W.	Cumulo strati.	.808	90.1	88.7	78.8	W. S.W.	Cumuli.
18	.826	87.9	86.6	77.3	W.N.W.	Clear.	.777	88.6	88.0	75.4	W.N.W.	Clear.
19	.883	88.4	88.0	76 9	N. N.W.	Cumuli.	.821	89.3	87.8	76.8	N. N. E.	Cumulo strati.
20	.907	90.0	88.4	75.0	N. N.W.	Ditto.	.849	89.8	89.0	75.4	N.	Cumuli.
21	.902	87.6	85.8	76.0	N. W.	Cumulo strati.	.838	88.3	87.3	76.8	N. W.	Cumulo strati.
22S	.903	87.2	85.7	76.4	W N.W.	Ditto.	.823	90.3	88.9	76.0	N. W.	Ditto.
23	.907	87.3	85.4	77.2	W.N.W.	Ditto.	.845	88.2	86.4	76.8	N. W.	Ditto.
24	.917	86.3	84.7	76.2	N. W.	Cloudy.	.851	86.8	84.8	76.0	W.N.W.	Ditto.
25	.968	86.9	85.2	76.4	N. W.	Cumulo strati.	.916	87.2	87.5	76.2	N. W.	Cumuli.
26	.987	85.4	84.4	75.3	N.N.W.	Ditto.	.925	89.9	88.4	76.0	W.	Cumulo strati.
27	.950	88.0	86.3	75.2	N.N.W.	Ditto.	.876	88.3	87.6	75.8	S. W.	Ditto.
28	.932	86 4	85.2	76.6	W. S.W.	Ditto.	.877	88.8	87.5	74.9	S.S. W.	Ditto.
29S	.957	88.8	87.0	77.3	N. W.	Ditto.	.899	90.3	88.3	76.9	W.N.W.	Ditto.
30	.959	85.7	84.7	75.9	W.N.W.	Ditto.	.884	89.9	88.3	75.6	N.N.W.	Ditto.
31	.960	89.2	88.2	77.0	W.N.W.	Ditto.	.887	90.7	89.2	75.4	W. S.W.	Ditto.
Mean	29.892	86.6	85.4	76.8			29.831	88.4	87.2	76.6		
Mean of the Corresponding month of last year.	29 879	86.7	86.2	78.6			29.816	87.6	87.6	79.4		

Days of the Month.	Minimum Pressure observed at 4 p. m. Barometer reduced to 32° Fahrenheit.	Temperature. Of the Mercury.	Temperature. Of the Air.	Temperature. Of Wet Bulb.	Wind. Direction at 4 p. m.	Aspect of the Sky.	Observations made at sunset. Barometer reduced to 32° Fahrenheit.	Temperature. Of the Mercury.	Temperature. Of the Air.	Temperature. Of Wet Bulb.	Wind. Direction at sunset.	Aspect of the Sky.
1S												
2												
3												
4												
5												
6												
7												
8S												
9												
10												
11												
12												
13	Inch.	°					Inch.	°				
14	29.626	84.1	83.9	79 6	S. E.	Cloudy.	29.638	81.6	81.5	78.8	S.E.Shp.	Cloudy.
15S	.656	83.0	82.9	78.7	S. Shp.	Ditto.	.671	81.8	82.1	77.5	S. S. W.	Ditto.
16	.803	84.3	84 2	77.7	W.S.W.	Ditto.	.814	82.9	82.3	78.0	W. S.W.	Gen'ly clear.
17	.800	89.4	87.4	78·4	W.	Clear.	.816	85 3	83 6	79.2	W.	Clear.
18	.768	87.8	86.0	75 4	W.N.W	Ditto.	.777	83.9	82 8	76 4	N. W.	Ditto.
19	.811	89 3	87 0	75.3	N. N. E.	Cumulo strati.	.822	85.7	81.4	75 7	N. N. E.	Cumuli.
20	.845	89.0	87.0	74.5	N. N.W.	Cumuli.	.859	84.7	84.0	74 0	N. N.W.	Clear.
21	.828	88.0	86.4	75 8	N. N.W.	Ditto.	.843	84.0	83.3	76.3	N. W.	Ditto.
22S	.819	88.6	86 4	74.7	N. W.	Cumulo strati.	.827	84 3	83.3	76.7	W.N.W.	Gen'ly clear.
23	.837	87.0	85.7	75.7	N. W.	Ditto.	.851	84.1	83 3	76 2	N. W.	Clear.
24	.848	87.8	85.7	75.0	W.N.W.	Ditto.	.861	84.1	83.0	76.0	W.	Ditto.
25	.904	87.7	86.0	74.9	N. W.	Cumuli.	.917	84 0	83 2	74.7	N. W.	Ditto.
26	.915	88.8	85 9	72.8	W. S.W.	Clear.	.930	84.2	82 0	74.2	W.S. W.	Ditto.
27	.867	87 3	86.2	75.3	W. S.W.	Cirri.	.880	83.3	82.8	76.1	W.S. W.	Cirri.
28	.879	87.2	85.3	73 0	S. W.	Cirri cumuli.	.890	82.6	82.0	74.8	S. W.	Cirro cumuli.
29S	.889	89.3	87 1	75.3	W.N.W	Cumulo strati.	.902	85.3	84.4	76 0	N. N.W.	Cirri.
30	.875	89.2	87.1	74 3	N. W.	Clear.	.888	85.4	84 0	73.4	N.	Clear.
31	.881	88.4	86.6	73.3	N. W.	Cumulo strati.	.892	84 1	82.9	74.3	N. W.	Cumulo strati.
Mean	29.825	87.6	85.9	75.5			29.838	84.0	83.1	76.5		
Mean of the Corresponding month of last year.	29.809	86.7	85.1	76.6			29.820	83.3	82.8	76.5		

Days of the Month.	Maximum and Minimum Thermometer. Maximum.	Mean.	Minimum.	Maximum Thermometer in sun's rays. Maximum.	Rain Gauges. Elevations. Feet. 40 Upper.	Feet. 4 Lower.	Moon's phases.	Days of the month.
1S								1S
2								2
3								3
4								4
5								5
6								6
7								7
8S								8S
9								9
10								10
11								11
12								12
13					3.70 *	3 86 *		13
14	85.8	79.9	74.0	100 9	1.18	1.55		14
15S	81.2	80 7	77.2	91.8	..	..		15S
16	86.2	81.1	75.9	100.5	..	..		16
17	90.4	83.5	76.6	113.3	..	..		17
18	89.8	84.3	78.8	111 8	..	..		18
19	91.0	83.0	75 0	115.3	..	..		19
20	90.7	83 0	75.3	114.0	..	..		20
21	89.3	82.1	74.9	111.9	..	..		21
22S	90.4	83.0	75.	116.8	..	..		22S
23	89.2	82 6	76.0	111.4	..	..		23
24	88.1	82.4	76.6	115.2	..	..		24
25	89.0	82 3	75.6	113 4	..	..		25
26	89.8	82.3	74 8	115.6	..	..		26
27	88 9	81 5	74 0	109 8	..	..		27
28	89.2	81.6	74.0	111.2	..	..		28
29S	90 8	83.8	76.7	116.0	..	..		29S
30	90 4	83 6	76.8	111.2	..	..		30
31	91.3	83.7	76.0	116.3	..	..		31
Mean	89.1	82 5	75.8	111.1	5.18	5.41		
Mean of the Corresponding month of last year.	89.0				5.15	5.86		

These Observations have been made for the most part, with a supply of new and first rate Instruments received into the Observatory, by orders of the Bengal Government; a brief description of the Instruments seems necessary.

1st.—The Barometer is a standard Instrument by Newman, diameter of the tube 0.504 Inches. The following is the comparative shewing of this Instrument and those Barometers which were in use at the Observatory prior to 1st of June, 1844.
Ditto „ „ „ „ „ 0.514 Ditto.

Barometer by Troughton used prior to the 1st of June, 1844. Observations reduced to 32° Fahrenheit.	29.193
Ditto.. Ditto Col. Everest used from 1st of June to 31st of August, 1844. .... Ditto ....Ditto	29.637
No. 52 Standard Barometer by Newman used from 1st of September, 1844..... Ditto ....Ditto	29.654
No. 86.... Ditto.... Ditto ...... Ditto......from 3d of April, 1847. .... Ditto ....Ditto	29.667

2nd.—The Thermometer is a Standard Instrument by Newman, on metal Scale and graduated to $\frac{1}{5}$ of a degree.

3rd.—Wet Bulb Hygrometer by Newman, graduated to single degree divisions, the difference between Standard Thermometer and dry Thermometer of this Instrument is + 0.2, the Temperature of the dry Bulb is taken from the Standard Thermometer, and in the event of the quantity moisture, dew point, or dryness, being required, it is necessary the difference adverted to be taken into calculation.

4th.—Maximum and Minimum Thermometer by Newman. The difference between these instruments, and the Standard Thermometer is + 0.7 for the former and 0.23 for the latter.

5th.—The Temperature shewn in Column 47 of a Thermometer, in sun's rays, is acquired by means of a Newman's Maximum Thermometer having a black bulb.—The above Instruments, excepting the Thermometer placed in the sun's rays, are fixed at above 4½ feet from the ground, to a post, in a thickly choppered house, and are freely exposed to the air and sheltered from any influence of Solar reflection.

The height of the Surface of the Mercury in the Cistern of the Standard Barometer in the Observatory attached to the Surveyor General's Office above the Mean Level of the Sea, having been deduced from a Series of Tide Observations taken from a Register kept at Kyd's Dock Yard, the result is recorded for general information.

	Feet.
Lowest Monthly Average of Mean Tides in the Months of February and March, above the Zero of Gauge at Kyd's Dock Yard, Calcutta,..............	8.38
Difference of Level between the Zero of Tide Gauge at Kyd's Dock Yard, and the Standard Barometer at the Observatory, ...	26.59
Height of Standard Barometer above the Level of the Sea, ...	18.21

* The fall of Rain from 1st to 13th inclusive. The Total fall of Rain from Jan. to Oct. 1848....58·33 Inches.

H. L. THUILLIER, Captain,
Officiating Deputy Surveyor General,
In charge Surveyor General's Office.